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The Engineer

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PUBLIC NOTICES

Sale by Tender.
G.P.O. BLACKFRIARS POWER STATION.
TENDERS are INVITED for the PURCHASE, DISMANTLING and REMOVAL of the PLANT from the above Power Station.
The plant consists of Modern Steam Turbo, 3-phase, 6600 volt Generating Plant, complete with Switchgear, Water-tube Boilers, Straining and Condensing Plant, together with Overhead Travelling Crane, Coaling Crane, and Conveyor Plant and all Accessories.
The station has recently been shut down owing to the Postmaster-General having now accepted a bulk supply from the power companies.
The plant was installed in 1910 and has been maintained in first-class condition, and may be inspected on application to the Executive Engineer, Post Office Engineering Department, 46, Upper Ground-street, Blackfriars, S.E. 1.
Forms of Tender, containing all particulars, can be obtained on application to the Controller, Post Office Stores Department, Studd-street Depot, Accounts Section, London, N. 1, or to the Engineer at the above-mentioned address.
Tenders will be received until 10 a.m. on Wednesday, the 16th June, 1926.
The Postmaster-General does not bind himself to accept the highest or any Tender.
BY ORDER OF THE POSTMASTER-GENERAL.
General Post Office,
June, 1926. 2492

The Director - General,
India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for—
1. STEEL SLEEPERS.
2. STEEL DISTANCE PIECES for RAILS.
3. STEEL KEYS for RAILS.
4. SWITCHES and CROSSINGS.
5. STEEL LIGHT VESSEL. Length Overall about 114ft.
Tenders due on the 22nd June, 1926, for Nos. 1 to 4, and on the 6th July, 1926, for No. 5.
Tender forms obtainable from the above. 2564

Assistant Architect Re-
QUIRED by the GOVERNMENT of PALESTINE for the PUBLIC WORKS DEPARTMENT. Salary £E460, rising to £E500 by annual increments of £E25, plus expatriation allowance of £E50 a year and plus a temporary and variable cost of living allowance of 5 per cent. of minimum salary of grade, plus £E27 a year. Candidates, single, 25 to 35 years of age, must have had not less than five years' experience in an Architect's Office and must be capable of Preparing Working Drawings, Specifications for Buildings, and Taking-out Quantities, preferably should be A.R.I.B.A. —Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14,609. 2546

Assistant Engineer Re-
QUIRED by the GOVERNMENT of PALESTINE for the RAILWAY DEPARTMENT. Three years' service and, subject to satisfactory service, with prospect of permanency. Salary £E400, rising to £E500 a year by annual increments of £E25, plus £E50 a year expatriation allowance, plus 5 per cent. temporary cost-of-living allowance and an additional amount of £E27 a year. Free passages and Government quarters at a low rental will be provided. Candidates, preferably single, aged 25 to 35, should have passed examinations to qualify for A.M.I.C.E. and have had at least five years' engineering experience on a home railway. Experience on maintenance of permanent way essential. —Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14587. 2491

Assistant Engineers (3)
REQUIRED for the NIGERIAN GOVERNMENT RAILWAY (CONSTRUCTION), for a tour of 12 to 18 months, with possible extension. Free passages and a commuted bush and travelling allowance of £9 a month whilst on duty in the Colony. Camp equipment provided. Outfit allowance of £80 on first appointment. Liberal leave on full salary. Salary, £480 for the first three years of service, then £510, rising to £720 a year by annual increments of £30, and thence rising to £920 a year by annual increments of £40. Candidates must have passed examination to qualify for A.M.I.C.E., or hold equivalent professional qualifications and possess experience on Railway location.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, clearly quoting M/14,155. 2548

Assistant Engineers (7)
REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service, the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £80 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 30 years of age, unmarried, must have passed the examination for A.M.I.C.E., or possess a Degree in Engineering recognised by the Institution as exempting from parts A and B of the examination. They must have had proper technical training and preferably have had not less than two years' subsequent experience on large Engineering or Municipal Works. Candidates possessing other engineering qualifications may apply.—Applications should be made at once by letter, stating age, qualifications and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14,485. 2460

Civil Engineer Re-
QUIRED by the GOVERNMENT of PALESTINE for the PUBLIC WORKS DEPARTMENT, for three years' service, with prospect of permanency. Salary, £E550, rising to £E750 by annual increments of £E25, plus expatriation allowance of £E50 a year, plus temporary and variable cost of living allowance of 5 per cent. on minimum salary, plus £E27 a year. Free passages. Candidates, single, aged 30 to 40, must be A.M.I.C.E., and preferably have been trained in a Municipal Engineer's office, must have had general experience on works and in charge of Construction and Maintenance of Buildings, Roads, Bridges, Water Supply and Drainage and the Preparation of Designs and Estimates for such works. Experience in Sea Walls is desirable. —Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, quoting M/14,607. 2565

PUBLIC NOTICES

Civil Engineer Re-
QUIRED by the KINGSTON and ST. ANDREW CORPORATION, JAMAICA, for three years' service, with possible permanency. Salary £700 a year. Free passages. Candidates, 30 to 45 years of age, must be fully qualified Civil Engineers, with experience in Sewage Disposal and Municipal Works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4 Millbank, Westminster, London, S.W. 1, quoting M/14,608. 2547

Civil Engineering Assis-
TANT REQUIRED, experienced in the calculation and design of Constructional Steel Work and Reinforced Concrete.
Preference given to ex-Service man.
State age, qualifications, detailed particulars of personal experience, and salary required. Box 982, c/o Pool's Advtg. Service, Ltd., 180, Fleet-street, E.C. 4. 2493

Civil Service (Air
MINISTRY). DESIGNERS AND DRAUGHTSMEN'S COMPETITION. A COMPETITION by interview will shortly be held for POSTS (pensionable under Civil Service conditions) for ENGINEERING DESIGNERS and DRAUGHTSMEN in the Air Ministry or at the Royal Aircraft Establishment, Farnborough, for Work on Aircraft Design and Calculations; Aero Engines, Design and Calculation; Perspective Sketches for Reproduction; Wireless and other Accessories; Ground Equipment and General Works Machinery and Plant. The scales of salary of the posts are :—
Designers, £250-15-£350 a year, plus Civil Service bonus.
Draughtsmen, Grade I., £160-10-£200 a year, plus Civil Service bonus.
Draughtsmen, Grade II., £125-7½-£150 a year, plus Civil Service bonus.
The competition will be open to (a) designers and draughtsmen serving at the Air Ministry or at the Royal Aircraft Establishment, and (b) other engineering designers and draughtsmen who have either served in H.M. Forces or served at sea and been awarded the British War Medal or the Mercantile Marine War Medal.
Candidates must have attained the age of 24, and (unless they are serving under the Air Ministry) must not have attained the age of 45 on 1st January, 1926. —Regulations and form of application may be obtained from THE SECRETARY, Air Ministry, S. 3 (Room 464), Adastral House, Kingsway, W.C. 2, by whom the completed form of application must be received on or before 19th June, 1926. 2447

PUBLIC NOTICES

Civil Engineer Re-
QUIRED by the GOVERNMENT of the GOLD COAST for the LAY-OUT of the TAKORADI TOWNSHIP, for a tour of not less than 12 nor more than 18 months' residential service in the first instance. Salary £480 a year for the first three years of service, then £510, rising by annual increments of £30 to £720 a year, and thence by annual increments of £40 to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and liberal leave on full salary. Candidates, aged 25 to 40, must be A.M.I.C.E. or possess a Degree in Engineering recognised by the Institution as exempting from parts A and B of the examination. Must be good Surveyors and have had experience in Road Construction, Town Planning and Drainage Work. Candidates possessing other engineering qualifications may apply.—Application should be made at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at head of application M/14,373. 2549

Department of Scientific
AND INDUSTRIAL RESEARCH. A JUNIOR ENGINEER is REQUIRED for the Forest Products Research Laboratory, South Farnborough, for work in connection with experimental timber drying kilns.
Candidates should have recently taken a good degree in engineering or possess equivalent qualifications.
Shop experience in steam engineering and aptitude for design are desirable.
Initial salary of the order of £250 per annum inclusive, according to qualifications.
Preference will be given, other things being equal, to ex-Service men.
Applications should be made on a form obtainable from the SECRETARY, Department of Scientific and Industrial Research, 16, Old Queen-street, S.W. 1, and must reach the Department not later than 12th June. 2435

Junior Technical Officer
REQUIRED for development work in connection with instruments and small precision apparatus. Candidates should have Honours Degree in Physics or Engineering and some works and drawing-office experience. Must be medically fit for flying and willing to fly as observer. Salary £176-15-£285 plus Civil Service bonus per annum, giving a present total starting remuneration of £278 10s. p.a. Preference given, other things being equal, to an ex-Service man.—Application should be made on a form to be obtained from the SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it must be returned, quoting reference number A. 95, not later than 26th June, 1926. 2495

PUBLIC NOTICES

Board of Education.
APPOINTMENT OF ASSISTANTS AT THE SCIENCE MUSEUM.
The Board of Education invite APPLICATIONS for TWO APPOINTMENTS as ASSISTANT on the HIGHER TECHNICAL STAFF of the SCIENCE MUSEUM, one in the Industrial Engineering Division and one in the Science Library.
Applicants must have attained the age of 22, and as a rule must not have exceeded the age of 30 on 1st April, 1926, but in exceptional cases applications from persons above the age of 30 on that date will be considered. Candidates who have served in H.M. Forces, the Royal Irish Constabulary, or as established Civil Servants may be allowed a deduction from actual age.
Candidates for the post in the Industrial Engineering Division will be expected to have had a sound general training equivalent to that required for a University Honours Degree in Engineering, and should also have had some practical experience. For the post in the Library candidates will be expected to have had a training equivalent to that required for a University Honours Degree in Physics, and a knowledge of some modern language is desirable.
The beginning salary for Men Assistants entering at the age of 25 or over is £250 per annum, together with the current Civil Service cost-of-living bonus (at present £119). The beginning salary for an Assistant entering below the age of 25 will be £200, rising to £250 on attaining 25. The salary scales of the Higher Technical Staff rise to £900 per annum with current bonus (if any).
The beginning salary for Women Assistants entering at the age of 25 or over is £230 per annum, plus bonus (at present £113). Women Assistants entering below the age of 25 will receive an initial salary of £200, rising to £230 on attaining the age of 25.
A fee of £5 will be payable by successful candidates before certification.
Further particulars and application forms may be obtained from the DIRECTOR AND SECRETARY, Science Museum, South Kensington, London, S.W. 7, and the application form, when filled in, should reach the Director not later than the 30th of June, 1926. 2489

Ministry of Transport.
ROADS DEPARTMENT.
EASTERN DIVISION.
WANSFORD BY-PASS, GREAT NORTH ROAD.
HUNTINGDON AND SOKE OF PETERBOROUGH.
The Minister is prepared to receive TENDERS for the CONSTRUCTION of the WANSFORD BY-PASS and BRIDGE, in the counties of Huntingdon and the Soke of Peterborough.
Form of Tender, conditions of Tender, conditions of contract, bill of quantities and specification may be obtained from the Divisional Road Engineer, Roads Department, Eastern Division, Ministry of Transport, 6, Whitehall-gardens, S.W. 1, upon payment of a deposit of £10.
This amount will be returned to the tenderer if his Tender is a bona fide one, and has not been withdrawn prior to the definite acceptance of a Tender by the Minister.
The drawings may be inspected at the Ministry, and copies of the specification, bill of quantities, &c., will be available on and after the 7th June, 1926.
Tenders on the official form, accompanied by a fully priced bill of quantities, and enclosed in a sealed envelope, endorsed "Tender for Wansford By-pass," must reach the undersigned by 10 a.m. on Wednesday, the 23rd June, 1926.
The Minister does not bind himself to accept the lowest or any Tender.
Dated this 2nd day of June, 1926.
(Signed) H. H. PIGGOTT.
Assistant Secretary.
Ministry of Transport. 2550

The High Commissioner
for India is prepared to receive APPLICATIONS for NINE APPOINTMENTS as CIVIL ENGINEERS
for temporary service on Indian State Railways.
Three years' agreement. Consolidated pay of Rs. 900-50-1000 per mensem for officers of non-Asiatic domicile and Rs. 600-50-800 per mensem for officers of Asiatic domicile. Initial pay according to age and qualifications.
Candidates must be British subjects and ordinarily not more than 35 years of age. They must have either (1) obtained a recognised University Degree or other distinction in Civil Engineering, or (2) be Chartered Civil Engineers, or (3) possess such other diploma or distinction in Civil Engineering as may be considered acceptable. In addition, they should possess at least three or four years' practical experience, preferably on railways or in railway works.
Information regarding the conditions of appointment and forms of application may be obtained from the SECRETARY to the HIGH COMMISSIONER for INDIA, 42, Grosvenor-gardens, London, S.W. 1. Last date for receipt of applications 30th June, 1926. 2496

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PUBLIC NOTICES

Armstrong College,

NEWCASTLE-UPON-TYNE.

(IN THE UNIVERSITY OF DURHAM.)

COURSES for the PASS DEGREE of B.SC. and the HONOURS DEGREE of B.SC. in MECHANICAL, MARINE, CIVIL or ELECTRICAL ENGINEERING, MINING, METALLURGY, or NAVAL ARCHITECTURE. The curricula of the Pass Degree and the Honours Degree normally occupy periods of three and four years respectively, but candidates presenting evidence of sufficient previous training may be allowed to proceed to either Degree after two years' residence.

The engineering laboratories have recently been extended, and all Departments are equipped for advanced tutorial and research work.

The NEXT SESSION COMMENCES on 5th OCTOBER, 1926.

Full particulars of the Courses may be had on application to

THE REGISTRAR,
Armstrong College,
Newcastle-upon-Tyne.

2512

MANCHESTER MUNICIPAL

COLLEGE OF TECHNOLOGY.

Principal: B. MOUAT JONES, D.S.O., M.A. (Oxon).

UNIVERSITY OF MANCHESTER

(FACULTY OF TECHNOLOGY).

DEGREE COURSES IN TECHNOLOGY.

The Prospectus gives particulars of the courses leading to the Manchester University Degrees (B.Sc. Tech., M.Sc. Tech., and Ph.D.) in the Faculty of Technology, in the following Departments:—

MECHANICAL ENGINEERING (Prof. G. G. Stoney, D.Sc., F.R.S.).
ELECTRICAL ENGINEERING (Prof. Miles Walker, M.A., D.Sc.).
MUNICIPAL AND SANITARY ENGINEERING (G. S. Coleman, D.Sc.).
CHEMICAL TECHNOLOGY, including General Chemical Technology, Chemistry of Textiles (Bleaching, Dyeing, Printing and Finishing), Paper Manufacture, Metallurgy and Assaying, Chemical Technology of Brewing, Electro-Chemistry, Colouring Matters, Foodstuffs and Fuels (Prof. F. L. Pyman, D.Sc., F.R.S.).
TEXTILE TECHNOLOGY (Prof. W. E. Morton, M.Sc. Tech.).
PHOTOGRAPHIC TECHNOLOGY (C. W. Gamble, O.B.E., M.Sc. Tech.).

Prospectus will be forwarded *free* on application to the REGISTRAR, College of Technology, Manchester. 2354

Crystal Palace School of Practical Engineering.

Founded 1872.

MECHANICAL AND CIVIL ENGINEERING DIVISIONS.

PRESIDENT: J. W. WILSON, M.I.C.E., M.I.M.E.
PRINCIPAL: MAURICE WILSON, M.I.C.E.

Assisted by Staff of Lecturers and Instructors. Thorough, up-to-date Practical and Theoretical Instruction. Course completed in 2 years. Students admitted at beginning of any term. 2240

"Norton and Gregory Engineering Scholarships, 1926."

The following Scholarships, total value £450, have now been awarded:—

Arthur John Moakes, St. Paul's School, West Kensington, London: £100 per annum, tenable for 3 years at Cambridge University.

Francis Luke Lambert, Westminster City School, London: £50 per annum, tenable for 3 years at London University. 2483

University of London.

The Senate invite APPLICATIONS for the UNIVERSITY READERSHIP in MECHANICAL ENGINEERING, tenable at King's College. Salary, £500 a year.—Application (12 copies) must be received not later than first post on 17th June, 1926, by the ACADEMIC REGISTRAR, University of London, South Kensington, London, S.W. 7, from whom further particulars may be obtained. 2448

University College of South Wales and Monmouthshire.

COLEG PRIFATHROFAOL DEHEUDIR CYMRU A MYNWY.

The Council of the College invites APPLICATIONS for the APPOINTMENT of ASSISTANT LECTURER and DEMONSTRATOR in ENGINEERING. The commencing salary will be £300 per annum.

Further particulars may be obtained from the undersigned, by whom three copies of application and testimonials must be received on or before June 14th, 1926.

D. J. A. BROWN,
Registrar.

University College,
Cardiff.
May 25th, 1926. 2464

Aberdeen Corporation Electricity Department.

FOR SALE.

ONE 720 K.W. Steam-driven D.C. GENERATING SET, consisting of a British Westinghouse 10-pole, single bearing Dynamo, 1510 amperes at 440 to 550 volts, with change-over switch to run shunt or compound, direct coupled to a Willans and Robinson 3-crank single-acting Engine of 3-V size, 230 r.p.m., 150 lb. per square inch steam. Blake-Knowles horizontal tube surface condenser, 3000 square feet cooling surface, to give 27in. vacuum. Edwards 3-throw air pump, gear driven by 12 H.P., 440-volt motor, 16in. atmospheric exhaust valve, Reavell patent oil separator and oil pump, gear driven by ¼ H.P., 230-volt motor. Plant may be seen running by appointment.

Offers for the whole or any portion of the above should be made to J. ALEX. BELL, City Electrical Engineer, Millburn-street, Aberdeen.
31.5.26. 2490

B. B. & C.I. Railway Company.

The Directors are prepared to receive up to Noon on Friday, 18th June, TENDERS for the SUPPLY of:—

1. DOG SPIKES.
2. MILD STEEL PLATES.

Tenders must be made on forms, copies of which, with specification, can be obtained at those offices on payment of £1 each for No. 1 and 10s. each for No. 2 (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1.
2nd June, 1926. 2545

The Madras and Southern Mahratta Railway Company, Limited,

25, Buckingham Palace-road, Westminster, S.W. 1, invite TENDERS for:—

STRUCTURAL STEEL WORK for SAW MILL and GANTRY (3 s., 1320 Tons Structural Steel work, 56½ Tons Galvd. Gutters, Pipes, Paling, &c. &c.).

Tenders are due in on 29th June, 1926, by 10.30 a.m. Tender form obtainable at above address; fee One Guinea, which is not returnable.

The Directors do not bind themselves to accept the lowest or any Tender. 2534

PUBLIC NOTICES

Bengal-Nagpur Railway Company, Limited.

The Directors are prepared to receive TENDERS for:—

SCREW COUPLINGS, &c.

Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after 31st May, 1926.

A fee of 20s. will be charged for the specification, which is not returnable.

Tenders must be submitted not later than Noon on Thursday, 10th June, 1926.

The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.

By Order of the Board,
R. C. VOLKERS,
Secretary.

2483

City of Bradford.

SEWAGE DEPARTMENT.

SURPLUS PLANT FOR DISPOSAL.

ONE "Ruston" No. 15 STEAM CRANE NAVVY, 2 c.y. bucket, 4ft. 8½in. gauge.

50 (about) "Hudson's" 20 c.ft., 2ft. gauge, "U" shape TIPPING WAGONS.

2 OPEN-TOP PRESSED STEEL TANKS, 140ft. by 48ft. by 12ft. high.

One 50 B.H.P. SEMI-DIESEL OIL ENGINE, by Robson.

One 10/20 H.P. "Titan" TRACTOR, by the International Harvester Corporation, Chicago.

The above plant has been little used and is in excellent condition, and may be inspected at the Esholt Sewage Disposal Works (station, Apperley Bridge and Rawdon, L.M. & S.).

Further particulars may be obtained from, and offers to be submitted to, the SEWAGE WORKS ENGINEER, Esholt Hall, near Shipley.
10th May, 1926. 2367

Great Southern Railways.

The Directors of the Great Southern Railways, Ireland, are prepared to receive TENDERS for the SUPPLY of the following:—

ONE LOCOMOTIVE STEAM CRANE, capable of lifting 5 tons at 16ft. radius (approximately) and 2 tons at 24ft. radius (approximately). The crane is to have motions for hoisting, lowering, travelling and derricking by steam power. All gears are to be machine cut and wearing surfaces case-hardened. Carriages are to be of the breakdown crane type with wheels, axles, springs, axle-boxes, buffers and couplings to the railway standard. Hand brake is also to be fitted. Boiler mountings, such as injectors, water gauge, &c., are to be to the railway pattern. Jib is to be 25ft. centres approximately. Gauge 5ft. 3in. House is to be provided for the driver.

The working speeds required are as follows:—

Hoisting	120ft. per min.
Slewing	4 revs. per min.
Travelling	350/400ft. per min.

One Lifting Magnet to be supplied, suitable for handling the following materials:—

Small Steel and Iron Scrap.
Boiler Plates.
Wheel Centres, Axles and Tyres.
Scrap Iron, Pig Iron and Iron Castings.

The crane is to generate the current for operating the magnet at 220 volts D.C.

Drawings and full specification are to be submitted with the Tender.

Forms of Tender (on which alone offers will be considered) can be obtained on application to the Company's Stores Superintendent, Inchicore, Dublin, on payment of One Guinea, which will be returned on receipt of a bona fide Tender embodying all the requirements mentioned above.

Tenders should be forwarded so as to reach the undersigned not later than 10 a.m. on Wednesday, the 23rd June, 1926, in the envelope provided for the purpose.

The Directors do not bind themselves to accept the lowest or any Tender.

C. E. RILEY,
Secretary.

Kingsbridge Terminus, Dublin,
June, 1926. 2538

Metropolitan Water Board.

FILTERED WATER MAIN, HAMPTON.

The Metropolitan Water Board invite TENDERS for the LAYING and JOINTING of approximately 280 Lin. Yds. of CAST IRON WATER MAIN, 48in. in diameter, through public and private roads and lands, together with contingent WORKS, including, inter alia, the BUILDING of a CONCRETE CHAMBER, along Lower Sunbury-road, in the Parish of Hampton, in the County of Middlesex.

The drawing, conditions of contract and specification may be inspected without payment at the offices of the Board, Chief Engineer's Department (Room 201), on and after the 10th June, 1926.

Forms of Tender, conditions of contract and specification, bills of quantities and schedules of prices, together with a copy of the drawing and a spare copy of the bills of quantities and schedules of prices, may be obtained on and after the 14th June, 1926, from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on production of an official receipt for the sum of £10, which sum must be deposited with the Accountant to the Board at 173, Rosebery-avenue, Clerkenwell, E.C. 1, and will be returned on receipt of a bona fide Tender, accompanied by all the above-named documents and drawing (with the exception of the spare copy of the bills of quantities and schedules of prices, which may be retained by the tenderer). Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays 10 a.m. and 12 noon). Cheques must be made payable to the "Metropolitan Water Board" and not to individuals.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk of the Board, Metropolitan Water Board, 173, Rosebery-avenue, Clerkenwell, E.C. 1," and endorsed "Tender for Filtered Water Main, Hampton," must be delivered at the offices of the Board (Room 122) not later than 10 a.m. on Monday, the 5th July, 1926.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1,
29th May, 1926. 2508

The Assam-Bengal Railway

COMPANY, Limited, is prepared to receive TENDERS for:—

TEN 2-8-2 LIGHT GOODS ENGINES.

Specifications and Tender forms may be obtained at the offices of the Company, Bishopsgate House, 80, Bishopsgate, E.C. 2. A fee of £1 1s. is charged, which cannot under any circumstances be returned.

Drawings may be had, at the cost of the tenderer, by application to Messrs. Hodges Bennett and Co., Ltd., 78, Queen Victoria-street, E.C. 4.

Tenders must be delivered at the Company's offices not later than Noon on Friday, the 18th June, 1926.

The Directors do not bind themselves to accept the lowest or any Tender.

By Order of the Board,
THOS. C. BRETT,
Acting Secretary.

27th May, 1926. 2494

Napier Harbour Board (New Zealand).

RESIDENT ENGINEERSHIP.

APPLICATIONS are INVITED for the above POSITION.

Salary £1250 per annum.

Canvassing members of the Napier Harbour Board will disqualify applicants.

Applications to be addressed to the SECRETARY of the NAPIER HARBOUR BOARD and delivered at the Harbour Board Office, Napier, New Zealand, not later than Monday, October 11th, 1926.

A copy of the conditions can be obtained from the Board's London Agents, Messrs. W. and A. McArthur, Ltd., 18/19, Silk-street, Cripplegate, London, E.C. 2. 2415

PUBLIC NOTICES

The Rickmansworth and Uxbridge Valley Water Company

invite TENDERS for the undermentioned SECOND-HAND MACHINERY:—

One "Robey" Open-Type High-speed Compound Vertical Engine, complete with stop valve, drain cocks, relief valves, fly-wheel for belt drive, 6ft. diameter by 13in. wide; crank shaft throttle governor, flexible coupling and three out-end bearings. The engine has cylinders of 11½in. and 18in. diameter by 11in. stroke and is capable of developing 90 B.H.P. with 100 lb. steam when running at 250 revolutions per minute.

One 21in. by 20in. Double-acting Bore-hole Pump of the concertina type, complete with driving gear, 120ft. of rods and rising main, rocking bobs, crossheads, guides, pump head, air vessel, and all necessary framing except two main girders over well mouth.

The above plant is now lying at the Company's West Drayton Pumping Station in the County of Middlesex and can be seen upon application to the "Superintendent of Works."

Rickmansworth and Uxbridge Valley Water Co.,
Rickmansworth (Herts.).

Form of Tender can be obtained on application to the SECRETARY of the COMPANY, 24, Ironmonger-lane, London, E.C. 2. 2520

The South Indian Railway

COMPANY, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of:—

1. POINTS and CROSSINGS, &c.
2. STEEL CRANKED FISH-PLATES.
3. STEEL BALLAST WAGONS and STEEL BRAKE VANS.

Specifications and forms of Tender will be available at the Company's Office, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tenders for Points and Crossings, &c.," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 18th June, 1926, in respect of Specifications Nos. 1 and 2, and the 25th June, 1926, in respect of Specification No. 3.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 10s. for each copy of Specification No. 1, of 2s. 6d. for each copy of Specification No. 2, and of £1 for each copy of Specification No. 3.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, Westminster, S.W. 1.

A. MUIRHEAD,
Managing Director.

91, Petty France, Westminster, S.W. 1,
1st June, 1926. 2544

Administrative County of London.

The London County Council invites APPLICATIONS for the undermentioned TECHNICAL APPOINTMENTS in the Chief Engineer's Department:—Two in the First Class (£250, rising by £15 annually to £310, thence by £20 annually to £350 a year); and Three in the Second Class (£120, rising by £10 annually to £150, thence by £15 annually to £240 a year). The salaries are based on pre-war conditions and are at present subject to temporary additions on the Civil Service scale, fluctuating according to the cost of living. On the existing basis the total remuneration represented by the minima and maxima is as follows:—

First Class, £377 and £504 13s. 10d. a year; Second Class, £263 12s. 4d. and £364 4s. 7d. a year. The next revision of the temporary additions will take place not later than 1st September, 1926.

Candidates must be corporate members of the Institution of Civil Engineers, with experience of the design and construction of civil engineering works, and the commencing salaries (within the scales) of the successful candidates will depend upon their qualifications and experience. There are prospects of promotion. Due weight will be given to the claims of those applicants who served or attempted to serve with H.M. Forces during the Great War. Candidates who did not serve in H.M. Armed Forces must be natural-born British subjects, and those not already in the Council's service must be under 40 years of age on 23rd June, 1926.

Applications must be made on the official form, copies of which (with the full particulars) may be obtained by sending a stamped addressed foolscap envelope (marked "Technical Assistants") to the Clerk of the Council, The County Hall, Westminster Bridge, S.E. 1.

Forms must be returned by 23rd June, 1926. Canvassing disqualifies.

MONTAGU H. COX,
Clerk of the London County Council.
2536

Sudan Government Railways

REQUIRE the SERVICES of a DISTRICT LOCOMOTIVE SUPERINTENDENT. Age 26 to 32, preferably single. Candidates should have been trained on a British Railway or in a Locomotive Builders' Works, and should have good knowledge of the working of a locomotive department. A.M.I.C.E. degree or equivalent desirable. Commencing salary £E480 to £E540 per annum, according to age and qualifications (£E equals £1 0s. 6d.). Progressive and pensionable post if satisfactory. Strict medical examination. Free first-class passage. Liberal leave and assisted passages.—Apply by letter to ADVISORY ENGINEER, Sudan Government London Office, Wellington House, Buckingham-gate, S.W. 1, marking envelope "District Loco. Superintendent." 2554

Two Drawing-office Assistants

REQUIRED in Chief Engineer's Department, London County Council. Commencing basic rates of pay 40s. and 65s. a week, rising by 2s. 6d. a week annually to 60s. and 80s. a week respectively. With present temporary additions total commencing rates of pay are 60s. 11d. and 104s. 1d. a week. Candidates must be under 40 years of age on 23rd June, 1926 (if not already in the Council's service), and must be neat and accurate tracers with experience in civil engineer's drawing-office.—Applications must be made on the official form, copies of which, with full particulars, may be obtained by sending stamped addressed foolscap envelope (marked "Drawing-office Assistant") to the CLERK OF THE COUNCIL, The County Hall, Westminster Bridge, S.E. 1. Forms must be returned by 23rd June, 1926. Canvassing disqualifies. 2537

Uxbridge Urban District Council.

CLERK OF WORKS.

CLERK of WORKS, with full knowledge and practical experience of Reinforced Concrete Work, REQUIRED to Take Charge in the Erection of Reinforced Concrete Water Reservoir at Uxbridge, Middlesex.

Applications, stating experience and qualifications, with salary asked, and copies of two recent testimonials, to be sent to the undersigned not later than Monday, the 14th day of June, 1926.

R. M. BLACKWELL,
Clerk.

Council Offices,
109, High-street, Uxbridge,
2nd June, 1926. 2560

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS UNLESS SPECIFICALLY REQUESTED.

WANTED, ENGINEER with Experience of Gas Producer and Coal Retort of Low-temperature Carbonisation for India. Salary according to ability.—Apply, PEDNEKER and CO., 1A, King Henry's-road, Chalk Farm, N.W. 3. 2528 A

SITUATIONS OPEN (continued)

ASSISTANT REQUIRED in Water Engineer's Office for Waterworks on South Coast of England; must be good Surveyor, Leveller and Draughtsman, possessing technical knowledge, and have had experience in Pumping Station and Distribution Departments, knowledge of Building Construction desirable; age about 23.—Write, with full particulars, salary required, and when disengaged, to Z. E. W. C., c.o. Deacon's, Leadenhall-street. 2505 A

CONSTRUCTIONAL STEEL WORK.—WANTED for works in Midlands, first-class MAN to Plan Progress and Urge Production through all stages. Must be energetic and persistent and able to increase output. State age, salary, and when at liberty.—Address, 2558, The Engineer Office. 2558 A

CONSTRUCTIONAL ENGINEERS. Possessing practical experience in Reinforced Concrete and General Building Work with contractors. Age 25 to 32; single. (1) For Near East, with knowledge of Arabic desirable; remuneration about £800, plus benefits. (2) for Singapore; remuneration about £600, plus benefits.—Call, C. W. PETTY and CO., Appointment Specialists, 98, Haymarket, S.W. 1. Phone, Gerrard 3412-3. P1964 A

CONSULTING ENGINEER and MANUFACTURER has an OPENING in his London Office for a PREMIUM PUPIL. Must have a good general education, some knowledge of drawing an advantage. Would be given a thorough training with a view to a permanent post when proficient. Interview by appointment.—Address, 1936, The Engineer Office. 2019 A

ENGINEER SURVEYOR REQUIRED by an Insurance Company; must possess a First-class or preferably an Extra First-class Certificate of the Board of Trade; a sound general and technical education essential. Commencing salary, £270 per annum.—Address, 2487, The Engineer Office. 2487 A

ESTIMATOR REQD., Thoroughly Expd. in Mass production methods on small engineering and instrument work. Man with planning exp. preferred.—Address, stating full particulars, salary reqd., 2542, The Engineer Office. 2542 A

PATENT AGENT.—American Firm of Patent Attorneys REQUIRE experienced MANAGER of Foreign Department for Patents and Trade Marks. Salary 4000 dollars per annum.—Address, P1950, The Engineer Office. P1950 A

QUALIFIED ENGINEER REQUIRED for Service in Singapore; practical experience in Reinforced Concrete Work and General Building Construction essential; 28-32, single.—Call immediately, W. G. JACKSON, Ltd., The Employment Agents, Carlton House, Lower Regent-street, S.W. 1. No preliminary fee. 1 A

REQUIRED AT ONCE for Midlands, OUTSIDE MANAGER for Firm of Ferro-concrete Specialist Contractors, who will be responsible for execution of various contracts. Candidates must be prepared to spend much of their time travelling. Only engineers with experience of similar work and capable of securing economical work should apply with full particulars and testimonials.—Address, 2533, The Engineer Office. 2533 A

REQUIRED for Important South American Railway, ASSISTANT to TELEGRAPH SUPERINTENDENT. Age 25/30. Must be thoroughly well experienced in Telegraph, Telephone, and Electrical Signalling Work. Salary about £600 p.a. Passage provided.—Reply, stating if single or married, education, training, experience, age, &c., with copies (only) of testimonials, to Box D. X., c/o Davies and Co., 95, Bishopsgate, E.C. 2. 2527 A

REQUIRED, JUNIOR ESTIMATOR. Accustomed to Railway Fittings and Accessories, preferably with Drawing-office experience. State age, experience, and salary required.—Address, 2551, The Engineer Office. 2551 A

REQUIRED, Young Energetic ENGINEER as Assistant Works Manager for Cement Works in South of England; previous knowledge of the trade essential. Correspondence treated in strict confidence.—Address, 2502, The Engineer Office. 2502 A

SHIFT ENGINEERS REQUIRED for Power station (16,000 K.W.) in a healthy part of the East. Applicants should state age, whether married or single, and all experience from commencement of apprenticeship.—Address, P1945, The Engineer Office. P1945 A

SUPERINTENDENT REQUIRED for Large Electrical Generating Station abroad. Applicants should give full information with regard to age, whether married and details of education and subsequent experience. No applications can be considered from those who have not previously held a post of similar responsibility.—Address, P1932, The Engineer Office. P1932 A

TECHNICAL ASSISTANT to MANAGING DIRECTOR REQUIRED by Motor Car Manufacturers; must have had first-class technical education and possess sound workshop experience and a good knowledge of Purchasing Steels and Raw Materials; experience in the control of Outside Contracts and Stores Records an advantage.—Address, stating age, experience and salary expected, 2561, The Engineer Office. 2561 A

TRAVELLERS WANTED to Sell Patent Adjustable Pipe Wrench and Ratchet Spanner in the British Isles to users. Not necessarily whole-time. Liberal commission. No expenses.—Write, THURLEY GRIP-ALL CO., Ltd., 209, New Cross-road, London, S.E. 14. 2513 A

WORKS MANAGER WANTED for Medium-size Engineering Works in North of England; good prospects to educated man of ability; age under 35 preferred; knowledge of Railway Work desired. Applicants should send details of qualifications, stating age and last salary.—Address, 2566, The Engineer Office. 2566 A

WANTED, First-class DRAUGHTSMAN, Having had previous experience with Electric and Steam Winding Engines and Air Compressors. Age between 30 and 45. State salary required. Only men with the above experience need apply.—HOLMAN BROS., Ltd., Camborne, Cornwall. 2535 A

WANTED, LEADING DRAUGHTSMAN, Used to Tramway Air Brake Design. Good salary and progressive position.—Address, 2534, The Engineer Office. 2534 A

CONSTRUCTIONAL STEELWORK DRAUGHTSMAN for Westminster Office, capable to Design, Take Off Quantities, Dimensions at sites and interview clients when necessary. State fully experience, age and salary required.—Address, P1955, The Engineer Office. P1955 A

DESIGNER REQUIRED, with Good General Engineering knowledge; one experienced in Laundry Machinery preferred.—Apply, stating age, qualifications, experience, salary required, to LAUNDRY DEPT., Baker Perkins, Ltd., Peterborough. 2557 A

DRAUGHTSMEN (MECHANICAL), London Area, WANTED, for first-class Design Work. Only thoroughly capable men need apply.—Address, 2523 The Engineer Office. 2523 A

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

The Coal Dispute.

ON Monday night the period expired during which the Government had intimated that it would continue to regard itself bound by the offer of £3,000,000 by way of a temporary subsidy to the coal mining industry. The last moments passed without any steps being taken by either side to the dispute to prevent the subsidy offer from lapsing. Meanwhile unofficial counsel was not silent. Mr. Frank Hodges, secretary of the Miners' International Federation, advanced a definite scheme as a basis of negotiations. He proposed that for a period of four years the hours of labour underground should be increased from 7 to 7½ hours per day, and that the hours of surface workers should be increased proportionately. Day workers' wages were not to be reduced and the piece-work percentages should be adjusted by the existing District Boards to correspond with the increase in hours, but in no case were they to be reduced by more than half the increase obtained when the hours were reduced from eight to seven. Sir George Hunter, the chairman of Swan, Hunter and Wigham Richardson, Ltd., was another prominent contributor to the discussion. He argued that the report of the Royal Commission on the Coal Industry was base certaind on conceptions which, if accepted, would have devastating results on the nation's economic life. Having exposed the alleged fallacies in the report, he proceeded to declare that the most urgent necessity in the coal industry was the restoration of the eight-hour day. The best service the Government could perform for the industry was, he argued, to repeal the Seven Hours Act of 1919 so as to leave the parties in a position effectively to negotiate an economic settlement without political interference. The Government should, he concluded, abandon the idea of placing the coal industry in leading strings as suggested in the Coal Commission's report. Masters and men have alike dealt adversely with Mr. Hodges' scheme and no doubt will do likewise with Sir George Hunter's. Many people, we fancy, are coming to Lord Emmott's opinion that outsiders who present schemes for the settlement of the coal dispute, even although their schemes are not bad, are likely to do more harm than good, and that it is sufficient for an outsider to propose a scheme for those in the industry to find all manner of faults with it. It is, therefore, satisfactory to learn that the industry itself has at last made a peaceward move. On Wednesday it was reported that the Mining Association of Great Britain had decided to invite the Miners' Federation to a conference under the presidency of an independent chairman. If that meeting can be arranged there are grounds for believing that it would lead to the re-opening of negotiations.

Engineers' Wages.

IT would no doubt be a mistake to suppose that the General Strike involved in its complete failure the end of the long continued dispute between the engineering employers and the engineering unions initiated by a demand from the men for an all-round increase of 20s. per week in wages. Nevertheless, strikes seem for the time being to be fairly generally out of favour as a means of enforcing wage demands. Even in the London district the Joint Engineering Trades Committee, representing the seventeen unions involved in the dispute, would appear to recognise the more than doubtful wisdom of calling a strike in the present conditions. When that body met on Monday night the result of a ballot among the members of its constituent organisations was laid before it. A substantial majority of the London men, it is stated, balloted in favour of striking to secure the increase demanded. Yet there was, so it is reported, a general feeling that the times were out of joint, and that to the wishes revealed by the ballot any decision as to giving it effect should be postponed. The adjournment was made until July 2nd, by which date it is anticipated that the results of similar ballots being taken in provincial centres will be available.

Oil Pollution at Sea.

WITH the coming into force in January, 1923, of the Oil in Navigable Waters Act, it became an offence punishable by a fine of £100 to permit the discharge or escape of oil from a ship into the waters of any harbour or river or into the sea anywhere within three miles from the British coast. Some other countries adopted similar legislation, but even though all did, the nuisance, it is certain, would not be wholly abated. A year or so ago the Board of Trade issued a report of investigations carried out into the matter of oil pollution round the British Isles. It was shown that the oil encountered had in some cases travelled long distances, and that the prohibition of its discharge in territorial waters did not necessarily secure the immunity of our shores and coastal regions from pollution. The international aspect of the question has now been recognised, and it is generally realised in all maritime countries that the prevention of oil pollution to be effective must be secured by extending the prohibition of the discharge of oil to ships on the high seas. This extension requires international action, and to that end the United States Government has now arranged to hold an international conference on the subject at Washington. This conference is due to assemble on Tuesday next. More or less effective means of dealing with the oily water discharged from ships were devised in anticipation of the coming into force of the Oil in Navigable Waters Act, but in general, as that Act applied only to territorial waters, the means employed commonly consisted of a barge or other vessel equipped with an oil-separating system, which barge was taken alongside the oil-burning or oil-carrying vessel, and received her bilge or other water before it was passed into the sea or harbour. Such barges will not, in general, be useful if the prohibition is extended to the high seas, and it would seem that the installation of oil-separating equipment on each vessel will be necessary. Such separators are already in use in several vessels, and it is understood that as a rule they recover sufficient oil to pay for their installation.

The Marseilles-Rhone Canal.

ON Tuesday water was admitted for the first time to the Rove tunnel, which forms one of the chief features in the scheme for providing communication by canal between the port of Marseilles and Arles on the river Rhone, and thence with the interior of France. This scheme was illustrated and fully described in our issue of October 27th, 1922. The Rove tunnel is 4 miles 704 yards in length, and pierces the Nerthe range of mountains between Marseilles and the Etang de Berre, a large salt-water lake lying inland to the north-west of the port. The section of the tunnel provides a canal width of 59ft., with a 6ft. 6in. track on each side. The depth of water in it is 13ft. 2in., and the height from the water surface to the top of the tunnel is 36ft. 3in. From the port of Marseilles a canal formed in the sea itself will carry the barges to the southern end of the tunnel. Emerging from the north end, they will traverse a cutting and so reach a canal formed in the Etang de Berre. From Martigne, on the southern shore of that lake, they will pass through existing, but enlarged, canals that will conduct them to Arles on the Rhone. The system throughout is on the sea level, and is therefore devoid of locks. The construction of the Rove tunnel was begun in 1911, but was delayed by the war. The work on it has been carried out by the Entreprises Chagniand, a company associated with the construction of the Lötschberg Tunnel. The German plant used in connection with the driving of that tunnel was removed to Marseilles to assist in the construction of the Rove tunnel. Spaniards and Arabs from North Africa provided the main supply of labour for the tunnel works. The scheme as here outlined is only part of a much more ambitious one aiming at the improvement of the port facilities of Marseilles. In its fully developed state the scheme will, it is intended, include the provision of docks in the Etang de Berre, which will be available to shipping unable to berth at Marseilles.

Shipowners and Airships.

ADDRESSING the Southampton Chamber of Commerce last week, Sir Sefton Brancker, Controller of Civil Aviation, dealt with the attitude which shipowners ought to observe towards airships and air transport generally, and urged them not to regard aircraft as rivals, but as adjuncts to the shipping industry. The shipping industry, he argued, was the natural organisation to run airship services, and he hoped that it would take over that duty when the experiments now about to be made in this country with commercial airships reached, as he was certain they would with luck reach, a successful conclusion. Aircraft, he held, would only carry first-class mails and passengers in a hurry to reach their destination. Neither the aeroplane nor the airship could compete with shipping for the heavy bulk of the traffic. Those responsible for planning the new docks at Southampton ought, he urged, to provide facilities at the docks for the arrival and departure of marine aircraft. It was no doubt difficult to say exactly how the position would develop, but the provision of slipways, sheds and moorings for aircraft would add little to the cost of the docks and might add great importance to them in the future.

Wireless Beam Stations.

THE report that technical difficulties have prevented the completion of the Australian-English beam wireless stations and that a radical modification of the original plans may be necessary is stated by an official of the Marconi Company to be quite incorrect. The delay in the completion of those stations has been caused by the difficulty in obtaining delivery of material from the contractors and by the illness for considerable periods of Senator Marconi and Mr. Franklin, who is responsible for the detailed design. The construction of the stations necessitates the carrying out of work which even the Marconi Company has not previously undertaken, and which has to be done in distant parts of the world as well as in this country. The company is supplying and erecting all the beam wireless apparatus at Grimsby-Skegness and at Bodmin-Bridgewater on behalf of the Government, which will operate the stations when they are completed. In Australia the stations are being erected by the Amalgamated Wireless Company; in Canada by the Canadian Marconi Company; in South Africa by the Wireless Telegraph Company of South Africa; and in India by the Indian Radio Telegraph Company. The Marconi Company is, however, making and supplying practically the whole of the wireless apparatus to be used at all the stations. Originally it was anticipated that the Grimsby-Skegness station, for transmitting and receiving messages to and from India and Australia, would be ready for operation early this summer, but it now appears that it will not be ready until the end of the year. Long-distance tests with the stations for communication with Canada will be carried out during the present month, and Senator Marconi, it is stated, has every reason to believe that the stations will prove as successful and efficient as anticipated.

Armstrong, Whitworth's Position.

THE annual report of Sir W. G. Armstrong, Whitworth and Co., Ltd., issued this week, reveals the fact that for the year 1925 the firm's net profit amounted to only £8498, as compared with £505,250 in 1924. Last year's figure, small as it was, was only arrived at after £900,000 had been transferred from the general reserve. That reserve now stands at £500,000, as compared with £1,400,000 in 1924 and 1923. The directors in the report state that the results for the year were materially affected by bad trade, high costs of production, and foreign competition. In addition, the efforts made to secure business to compensate for the serious reduction in armament orders did not give the results expected. Investigation, they say, has shown that the original estimates of profits on certain important contracts will not be realised and, indeed, that heavy losses will be incurred. The extent of these losses is not as yet fully known, but it has been considered essential to transfer £900,000 from the general reserve. The greater part of this sum will be required to write off the losses already incurred. Five of the firm's eight directors have tendered their resignations, including the chairman, Sir Glynn West, who will be succeeded by Lord Southborough, a member of the Armstrong board and a director of, among other companies, the London Underground Electric Railways. The other directors who are retiring are Mr. J. M. Falkner, Sir G. H. Murray, Sir C. L. Ottley, and Lord Sydenham. The annual meeting is to be held on the 8th inst.

The Electricity Bill.

AN important letter on the Electricity Bill, consideration of which is to be resumed next week, appeared in *The Times* on Thursday last, over the signatures of nine men closely connected with electricity supply, amongst them Mr. R. A. Chattock, President of the Institution of Electrical Engineers. The signatories to the letter say that whilst they are not opposed to standardisation and interconnection, they are "satisfied that the cost of a general standardisation of frequency has been seriously underestimated, and could not be borne by the electricity supply industry without imposing a burden upon the users of electricity." They hold that the Bill, unless further emended, will diminish efficiency, introduce further bureaucratic administration without financial responsibility and discourage enterprise. They are anxious to support any measures that are calculated to spread the use of electricity, but a careful study of the Bill has convinced them that "its provisions are inimical to the economic development of electricity supply."

Steamers *versus* Motor Ships.

SOME very interesting remarks on the commercial value of steamships and motor ships were made last week by Sir John Latta at the annual meeting of the Nitrate Producers' Steamship Company, Ltd., over which he presides. His company has recently ordered two steamers in preference to two motor ships, for Sir John believes that for general cargo-carrying purposes steamers in certain circumstances yield a higher return on the capital invested in them than do motor ships. While admitting that motor ships possessed some advantages, he argued that for general trading vessels with a speed of 11 knots, a better return was given by fitting them with quadruple-expansion engines using superheated steam than by adopting internal combustion engines. A motor ship of 9000 tons capacity, fitted with electrically driven auxiliaries, cost at present, he said, some £35,000 more than a steamer of 10,000 tons capacity. Sir John also bases his preference for steamships on a belief that the price of coal is more likely to decline than the price of oil fuel, and on the consideration that it is of very great importance to the British Empire that coal should remain the cheapest source of power. These remarks by a shipowner who is prepared to back them up with orders for steamers rather than motor ships will no doubt encourage those naval architects and engineers who are seeking to retain supremacy for the steamship. It ought, however, to be observed that Sir John Latta's remarks are based on the present cost of motor ships. There can be little doubt that the motor ship with a history of only about fifteen years will as time goes on tend to cheapen much more proportionately than the steamship with its life of more than a hundred years.

The Langerbrugge Power Station.

(By our Special Representative on the Continent.)

THERE is no power station in Europe which is of more interest to those who advocate higher steam pressures and temperatures than that of the Centrales Electriques des Flandres at Langerbrugge, near Ghent. Under the enterprising management of M. Léopold Herry, its chief engineer, this company has put itself in the forefront of central station practice by using steam at the highest temperature yet commercially adopted in the world, and at the highest pressure for which ordinary boilermaking methods are adequate. The Langerbrugge station now contains three boilers, capable of a normal aggregate output of 79,200 lb. of steam per hour, working at a gauge pressure of 56 kilos. per square centimetre, or practically 800 lb. per square inch, and at a temperature of 842 deg. Fah. The size of the installation takes it out of the class of experiments, in the usual sense of the word, and testifies to an engineering courage on the part of M. Herry, and the builders of the machinery, which appears to have been abundantly justified by results. Before describing the equipment of the Langerbrugge station, however, it will be well to give an outline of the history and the present position of the undertaking which has shown such enterprise.

The Centrales Electriques des Flandres was formed as a limited liability company in July, 1911, with the object of supplying electricity within a radius of about 25 kiloms., covering an industrial area which was rapidly developing along the banks of the maritime canal from Ghent to Terneuzen. The city of Ghent had started its own municipal station the year before. The company began by absorbing and co-ordinating the various small undertakings serving parts of the area, and in 1913 began the construction of a power station for itself. The site chosen was at Evergem, about 4½ miles from the centre of Ghent, and not far from the bridge over the canal at Langerbrugge. The station lies between the canal and the Ghent–Terneuzen railway, so that coal and materials can be brought to it both by rail and water. The site covers an area of nearly 12½ acres, with a frontage of some 900ft. on the canal. The latter at this point is nearly 400ft. wide, and about 28ft. 6in. deep, so that an ample supply of condensing water is available. Since the station, moreover, is in the centre of the area to be served, it enjoys all the facilities that could be desired for economical supply. Like nearly all continental power stations, that at Langerbrugge is handsome and dignified architecturally. The effect is not obtained by any attempt to imitate classic styles, but by the construction of a building obviously appropriate to its purpose and worthy of the importance of the machinery it houses. Continental architects and engineers seem to have a taste in such matters that is all too rare in England.

The station first went into service in June, 1914, and was hardly more than in working order when war broke out. It then contained two 2000-kilowatt turbo-alternators, running at 3000 revolutions per minute, generating three-phase current at 12,000 volts and 50 cycles. Steam was supplied by three Babcock and Wilcox marine type boilers, at 200 lb. pressure and 620 deg. Fah. temperature. Two of the boilers had chain grates and induced draught, one being arranged for forced draught as well. The third boiler had a stoker of the retort type for burning coke breeze. Make-up feed water was supplied by a Prache and Bouillcn evaporator, the first of its type to be used in a central station. Shortly before the close of the war, the Germans wantonly destroyed the plant with bombs, the idea being apparently to hinder the economic revival of the country. The condition of the station after the Armistice in November, 1918, will be gathered from Figs. 9 and 10, page 582. Except that the walls were still standing, it was an utter and apparently irreparable ruin. In addition to wrecking the machinery and buildings, the Germans had also destroyed a large part of the overhead transmission system, had cut the underground cables in innumerable places, and had destroyed or stolen the equipment of many of the sub-stations before their retreat from the country. In spite, however, of the formidable nature of the task before them, the company got the power station into operation again and was supplying energy to a part of its customers within a month of regaining possession of the property.

A new period in the history of the station started in 1919, when two boilers for a working pressure of 20 kilos., or 285 lb. per square inch, were ordered. It had been intended to raise the station pressure from 200 lb. to 350 lb., but a turbine for the latter pressure could not be obtained in time, and the matter was urgent. It was at this time that M. Herry took up the question of really high pressures with the turbine builders and boilermakers, and urged them to provide apparatus which would enable such pressures to be employed in central stations. This was the beginning of a serious study of the problem, which has resulted in developments, not only at Langerbrugge, but on the other side of the Atlantic. Before any extra high-pressure plant was obtainable, however, further extensions were required at Langerbrugge, and the two 285 lb. boilers erected in 1920 were followed two years later by another pair of the same size and type. These four boilers were rated at a normal evaporation of 33,000 lb. per hour apiece. During the year 1924 another pair of boilers, rated at 50,600 lb. per hour, were installed, and during 1925 three 810 lb. boilers were put down in the place of the original three 200 lb. boilers, which, with the original pair of turbines, had been taken out and are now running in the company's other station at Zeebrugge.

The Langerbrugge station, as it exists at the present time, is of thoroughly modern design. The stores and administrative offices are in a separate building alongside, the power-house building containing nothing but machinery and apparatus. A single-sided boiler-house has been adopted, with all the advantages of accessibility, natural lilumination and ventilation which such an arrangement gives. Fig. 1 is a view in the boiler-house. Starting from the older end of the building, the boilers are numbered consecutively. Nos. 1, 2 and 3 shown in the foreground of Fig. 1 are the new high-pressure boilers, which replace the very earliest boilers installed; Nos. 4, 5, 6 and 7 are the 33,000 lb. boilers put down in 1920–22; while Nos. 8 and 9 are the 50,600 lb. boilers put down in 1924. The following table summarises the leading

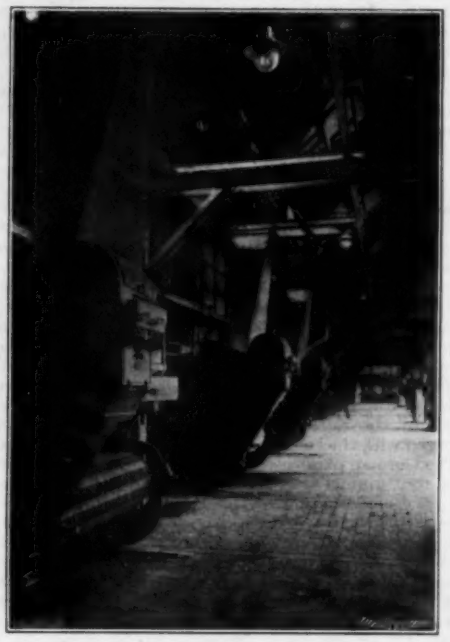


FIG. 1—INTERIOR OF BOILER-HOUSE

particulars of boilers Nos. 4 to 9 inclusive. The others will be referred to in more detail later.

TABLE I.

Boiler No.	4, 5, 6, 7	8, 9
Date of installation	1920–1922	1924
Heating surface, sq. feet	4960	7750
Superheater surface, sq. feet	1775	2580
Economiser surface, sq. feet	2560	3910
Grate area, sq. feet	196	294
Number of grates	Two	Three
Size of grates	7ft. by 14ft.	7ft. by 14ft.
Normal evaporation, lb. per hour	33,000	50,600
Maximum evaporation, lb. per hour	44,000	66,000
Safety valve pressure, lb. per sq. in.	285	305
Temperature of steam, deg. Fah.	620	620

All these boilers are provided with both forced and induced draught, and soot blowers are fitted to each. In order to be able to maintain steam in case of failure of the grates, or to force the boilers at times of peak load, oil burners are fitted at the back of each furnace. They will either burn fuel oil or colloidal fuel, which is a mixture of 50 per cent. coal dust with oil. The steam piping is so sectionalised that each pair of boilers can be used in connection with one of the turbines, thus forming an independent power group. The bus-bars are also sectionalised, so that each boiler and turbine group can feed a separate part of the system. Hence any accident which may occur can be restricted in its effects, both inside and outside the station, and the continuity of the general service will be unimpaired.

The make-up feed water, as in all modern stations, is obtained by evaporation. The evaporation plant is housed, at the newer end of the engine-room. There are two Prache and Bouillon vertical type evaporators standing on the basement level. One of these has a capacity of 2200 lb. and the other of 8800 lb. of distilled water per hour. The raw water supplied to them is not taken from the canal, but is drawn from an artesian well. The make-up water leaving the evaporators is de-aerated by being passed through one of the main turbine condensers before it enters the feed range. The feed system is entirely closed, so that trouble from the corrosion of boilers and economisers, owing to dissolved gases, is eliminated. The feed piping is of copper throughout. In general, the boilers are fed by electrically driven feed pumps, but there are in addition a pair of single impeller pumps driven by a steam turbine at 6600 revolutions per minute, with a delivery pressure of 340 lb. per square inch.

The main generating units consist of four similar Brown-Boveri turbo-generators, each developing 6600 kilowatts at 3000 revolutions per minute. Each turbine has a double condenser, allowing one part to be cleaned whilst the turbine works at reduced output with the other in service. All the auxiliary pumps for each unit are mounted on a single shaft which is normally driven by an electric motor. A steam turbine is also mounted on the same shaft, and comes into action automatically should there be any interruption of the electric supply. The provision for bringing the turbine into operation is simple and ingenious. The working speed of the turbine is arranged to be somewhat lower than that of the electric motor. When the motor is driving, therefore, the speed keeps the steam throttle valve shut, owing to the action of the turbine governor. Upon any failure of the current the motor begins to slow up, and the governor at once admits steam to the turbine, which then takes charge.

A general view of the turbine-room is given in Fig. 11, page 582. The main turbines are directly coupled to generators rated at 8250 kilovolt-ampères. They supply three-phase current at 12,000 volts between phases and at 50 cycles. They are excited at 110 volts by exciters on the shafts. Excitation current is further assured by a battery of accumulators and by independent generators. Every generator is furnished with its own air filter. The switchgear is arranged on three floors lengthwise of the engine-room. The operating board is on the second floor, and commands a good view of the generating sets. Since the first installation, the switchgear has been largely increased, for not only has the capacity of the plant been multiplied, but provision has had to be made for a 36,000-volt cable linking the station with Zeebrugge. The more recent switchgear is of the completely armoured type, on the "Coq" system. Every piece of the apparatus is enclosed in a tank of oil, so that no live part is accessible. Armoured switchgear is not only safer, but is vastly more compact than the earlier "air-insulated" type.

THE HIGH-PRESSURE PLANT.

We will now turn to the high-pressure steam plant, which makes Langerbrugge so distinctive amongst power stations. It was M. Herry's first intention to adopt a pressure very considerably in excess of that eventually selected. Pressures up to as high as 1500 lb. per square inch were seriously discussed, and it was not any doubt of the practicability or the safety of such pressures which led to the final adoption of 56 kilos., or 800 lb. per square inch. The reason lay in the conditions of the station. The main steam range was working with steam at a pressure of 285 lb. per square inch and a temperature of 625 deg. Fah. It was very advisable that the new plant should exhaust into that range, thus contributing to the steam supply of the existing turbines, rather than using an independent turbine for the final expansion of the high-pressure steam. It followed therefore that the steam, after leaving the high-pressure turbine, should still carry a considerable amount of superheat, so as to approximate to the range conditions. The best way to secure that object was to work with the highest possible temperature in the first place, and to choose such a pressure that a sufficient superheat would still remain after the steam had been reduced by the first turbine to a pressure of 285 lb. per square inch. These considerations indicated an initial pressure of 810 lb. per square inch and an initial temperature of 826 deg. Fah., the latter being probably the highest steam temperature ever commercially used up to the present time. Had a much higher initial pressure been chosen, the steam after expansion to the range pressure would have been insufficiently superheated or even wet, and it was M. Herry's wish to avoid the complications of re-heating. What he did, in short, was to "compound" his station, by adding a high-pressure plant suitable to work in conjunction with his existing plant.

The high-pressure equipment consists of three boilers and a turbo-generator, together with all the necessary auxiliary apparatus. The boilers are of the Babcock and Wilcox's marine type, and are fitted with the firm's compartment type chain grate stokers and air heaters. No economisers are provided, as the feed water is heated to 384 deg. Fah. by steam before entering the boilers. The general arrangement of one of the boilers is illustrated in the upper drawings in our Supplement, while Table II. gives the leading particulars:—

TABLE II.—*Particulars of Babcock and Wilcox High-pressure Boilers.*

Normal output of steam per hour	12,000 kilos. (26,400 lb.)
Steam pressure (load on safety valve)	56 kilos./cm². (800 lb./sq. in.)
Steam temperature	450 deg Cent. (842 deg. Fah.)
Boiler heating surface	442·7 sq. metres (4765 sq. ft.)
Superheater surface	100 sq. metres (1173 sq. ft.)
Air heater surface	455·4 sq. metres (4900 sq. ft.)
Grate area	9·1 sq. metres (98 sq. ft.)
Temperature rise in air heater	200 deg. Cent. (360 deg. Fah.)

The boiler drums, which are of 3ft. 6in. internal diameter, are not of the hollow forged construction which has been adopted for high pressures in certain

cases, but are built up of plates in the usual way. The shell is 1⅛in. thick, and is strengthened with a plate of equal thickness where it is entered by the tubes. All the water tubes are 3in. diameter and 13ft. long. The superheater tubes are 1½in. diameter, and are expanded into cylindrical headers. The water level in the drum is shown by a Burnett-Brearley indicator, which consists of a pointer actuated by the weight of a movable chamber. This chamber moves without involving any sliding motion of a joint or without requiring any packing, as it is connected by flexible pipes to the boiler proper. It is in communication with the steam and water spaces of the boiler, respectively, by means of these flexible pipes. Its water level therefore corresponds to the water level in the boiler. When the latter is high, the extra weight of water in the chamber causes the latter to descend, and *vice versâ*, the motion of the chamber

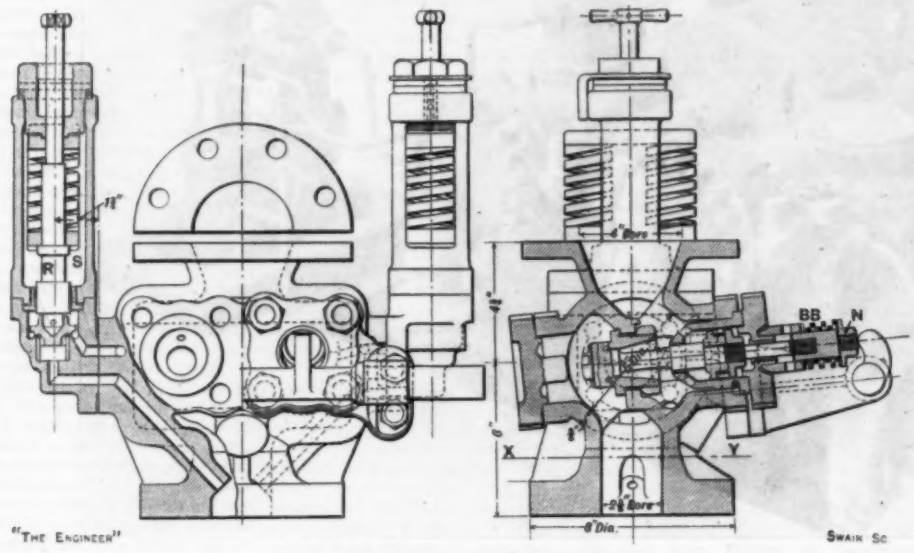


FIG. 2—DOUBLE FULL-BORE SAFETY VALVE

being magnified by mechanical means to give a large and clear reading of the pointer. Immediately behind the boiler, and the full width of the latter, is an air heater of Messrs. Babcock and Wilcox's tubular type. The flue gases enter this at the top, pass down through a nest of straight tubes, 2¾in. in diameter by 16ft. long, and are then delivered to the steel slack by the induced draught fan. The air for the furnaces is circulated around the outside of the tubes by means of baffles and delivered under pressure by the forced draught fan to the stoker, which is of the latest compartment type that permits the air supply to any section of the grate to be independently regulated. Although only 7ft. wide, a flat suspended type of arch has been adopted, as it gives uniform combustion conditions right across the grate.

It will be observed that there is nothing "freakish" about the boiler plant. It represents, indeed, very closely Messrs. Babcock and Wilcox's standard practice, with only such modifications as are indicated by the specially high pressure and superheat required. There is no economiser, the feed water being heated by other means, and the waste heat in the flue gases is restored to the system by means of the air heater. The boiler proved absolutely steam tight under its working pressure, and was put into service without any difficulty whatever.

In all work with very high-pressure steam, the design and construction of the necessary valves are of the greatest importance, for any escape of steam under such pressures is liable to cut the valve seatings and very quickly cause serious trouble. The various high-pressure valves in connection with the Langerbrugge boilers were supplied by Cockburn's, Ltd., of Glasgow, to Messrs. Babcock and Wilcox's requirements. The safety valves and stop valves are of the Cockburn-McNicoll patented design, which would seem to eliminate all danger of damage from the cause mentioned. Two kinds of safety valves are used, a double full-bore valve on each boiler drum, and a single full-bore valve on each superheater outlet. They both act on the same principle, which will be clear on studying Fig. 2, which represents the former type. The body of the valve is a steel casting, communicating with the saddle to which it is bolted by a branch of 2¾in. diameter. Ports from this branch lead the steam to the underside of a pair of control valves of 1½in. diameter, which are situated one on each side of the main valve body. One of these control valves is shown in section in Fig. 2. When the steam pressure rises to that for which the control valves are set, the latter rise from their seats and allow the steam to pass, by means of other ports, to the back of pistons on the main valve spindles. The main valves are opened to their full amount by the steam pressure thus admitted behind the pistons. When the boiler pressure drops, the control valves are closed by their springs, and the steam holding the main valves open can escape through small holes to the atmosphere, thus allowing the unbalanced boiler pressure acting on the main valves to return them to their seats. The return of the main valves is also assisted by the concentric closing springs on their spindles. The main valves may be opened by hand at any time by means of the casing spindle. Rotation of this spindle causes short levers to depress the main valve spindles, thus forcing the valves from their seats.

The enlarged details Fig. 3 and 4 will show how the seats of the main valves are protected against the cutting action of the steam. Normally, the valves are kept hard shut by the boiler pressure, and when they are opened by the action of the control valves, they open at once to their fullest extent. The throttling of the steam through the valves does not take place at the seats at all. The throttling orifice is round the valve spindle, and the velocity is much reduced when the steam passes the seats, which, moreover, are protected by their form from its direct action. It may be mentioned that stainless steel is largely used in the construction of the safety valves. The control valve chests with their valves and spindles are all of that material, as also are the main valve seats, nuts and spindles. Nickel alloy is used for bushes, piston rings and other internal parts, while the main chest and its covers are, of course, of cast steel. The valve casings were subjected to a test pressure of 1600 lb. per square inch, or double the normal working pressure before dispatch.

The Cockburn-McNicoll stop valves are of two sizes, 4in. valves being fitted as boiler junction valves and to connect each boiler to the main high-pressure range, while 5in. valves are used in the range and in the steam pipe leading to the turbine. One of the 5in. stop valves is illustrated in Fig. 5. The body and cover are of cast steel, while the valve with its spindle bush and the valve seating are of stainless steel. Steam enters the valve from the left-hand side, as shown in the drawing, and passes up through the circular seating, which has a bore of the full pipe line diameter of 5in. The valve itself, when closed, is in contact with the seating on two circular faces, as nearly as possible of the same diameter, so that the resultant steam pressure, tending to hold the valve to its seats, is quite moderate. The area inside the upper facing is in free communication with the down-stream side of the valve, and thus cannot contribute to any unbalanced pressure. The upper face of the screwed bush which holds the valve and spindle together is finished flat by grinding, and there is a similarly true ground surface formed above it on the inside of the cover. By opening the valve to its utmost extent these surfaces are brought into

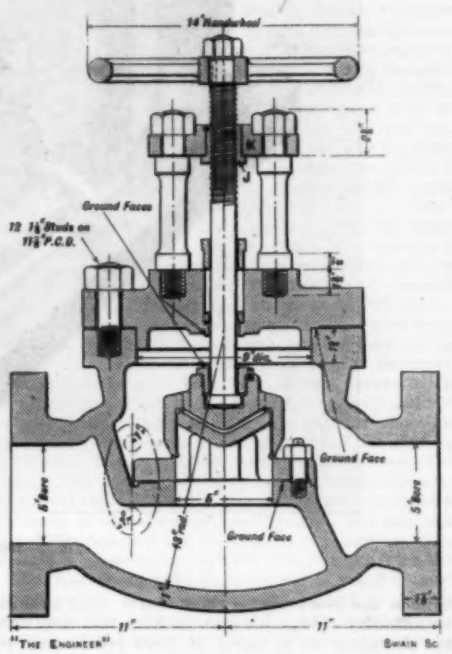
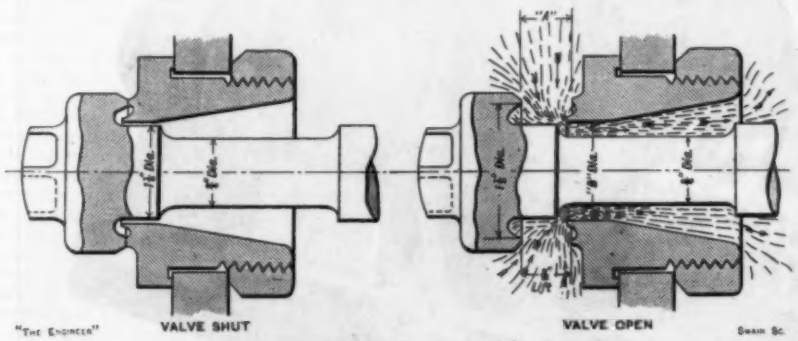


FIG. 5—5in. STEAM STOP VALVE



FIGS. 3 AND 4—MAIN SAFETY VALVE, SHUT AND OPEN

contact and make a steam-tight joint, so that the gland may be removed and the spindle packing attended to, while the valve is open and working under pressure. The stop valve illustrated works with its pipe axis vertical, so that the drain has to be in the position shown in order to drain the down-stream piping at its lowest point. As in the case of the safety valves, all stop valves were tested at 1600 lb. pressure before being put into service, and the same remark applies also to the isolating valves fitted next to the junction valves on each boiler. One of these isolating valves is illustrated in Fig. 6.

The turbo-generator to work with the new plant at Langerbrugge was, as has already been stated, designed and constructed by Brown, Boveri and Co., Ltd., of Baden. The turbine is constructed to take

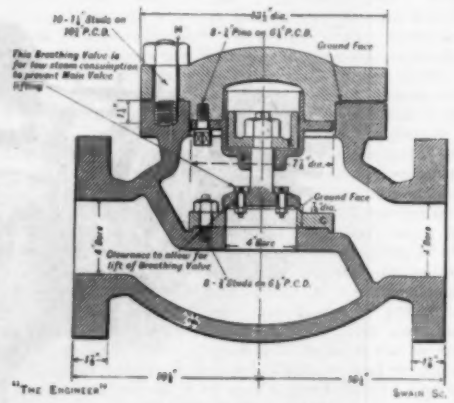

10 - 1¼" Studs on 10½" P.C.D.
8 - ¾" Pins on 6½" P.C.D.
Ground Face
This Breathing Valve is for low steam consumption to prevent Main Valve lifting
Ground Face
4" Bore
Clearance to allow for lift of Breathing Valve
8 - ¾" Studs on 6½" P.C.D.
"THE ENGINEER"
SWAIN Sc.

FIG. 6—ISOLATING VALVE

steam at the stop valve at a gauge pressure of 710 lb. per square inch (50 kilos. per square centimetre), and at a temperature of 828 deg. Fah. (442 deg. Cent.). It exhausts at a gauge pressure of about 285 lb. into the main steam range of the station. The rated output of the plant under these conditions is 2000 kilovolt-ampères. A general view of the turbo-generator is given in Fig. 7, while Fig. 8 shows it with the turbine casings and the gear covers removed. These views were taken at Messrs. Brown Boveri and Co.'s works, and the appearance of the set in the power-house at Langerbrugge is shown in Fig. 12, page 582. There are, as will be seen, two separate two-stage impulse tur-

bines, working in series with each other, as regards the steam flow, and in parallel with each other mechanically. Each turbine consists of two single impulse wheels, having a mean blade diameter of 14¼in., and running at 8000 revolutions per minute. The turbines are overhung on their shafts, thus avoiding the difficulty of high-pressure packing, and they drive the alternator at a speed of 1500 revolutions per minute, by means of reduction gearing. Current is generated at 12,000 volts and 50 cycles. Cast steel is, of course, used for the turbine casings, the wheels, blading and labyrinth packings being of special alloy steel.

The general design of the turbines will be understood from the left-hand lower drawing in our Supplement, and reference to the right-hand lower drawing will make clear the kind of valve gear employed. Steam from the boilers is admitted by the stop valve which stands apart from the turbine proper, as shown in Fig. 12. Alongside the stop valve and working in the same casing—see the right-hand lower drawing—is the governor valve, which is operated by an oil pressure relay under the control of the centrifugal governor. The only connections between the valve gear and the turbine are flexible pipes. The way in which steam is brought to the first turbine and from it to the second turbine will be clear from Fig. 12 and in the drawing. Instead of single pipes being used, the connections are made by a number of "macaroni pipes," as they are called in the station, working in parallel with each other. The idea is to secure perfect flexibility, so that no expansion of the steam pipe, or distortion due to temperature or pressure, can possibly affect the turbines or their gearing. The whole design of the turbine plant is very attractive, and the fact that it was put into service with no difficulties at all is evidence of a very creditable amount of foresight on the part of the builders.

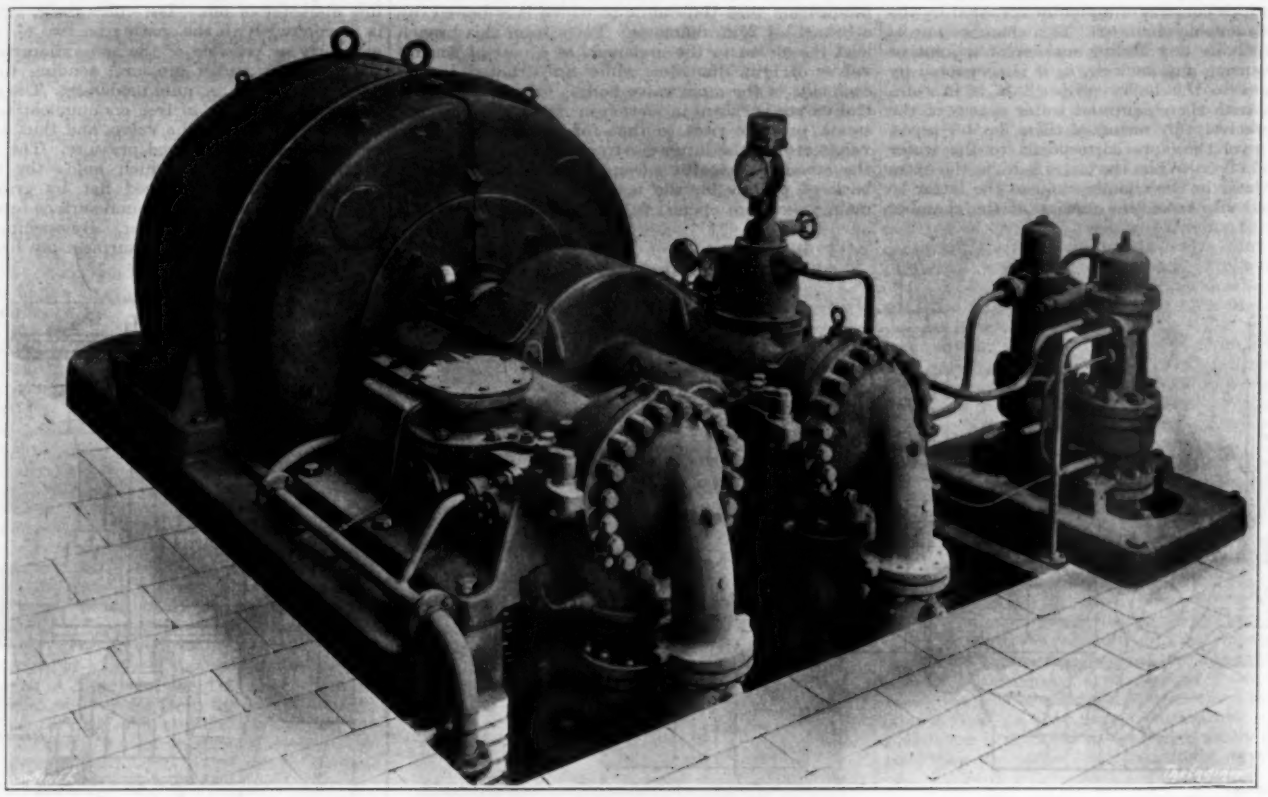


FIG. 7—2000 K.V.A. HIGH-PRESSURE STEAM TURBO-ALTERNATOR—BROWN BOVERI

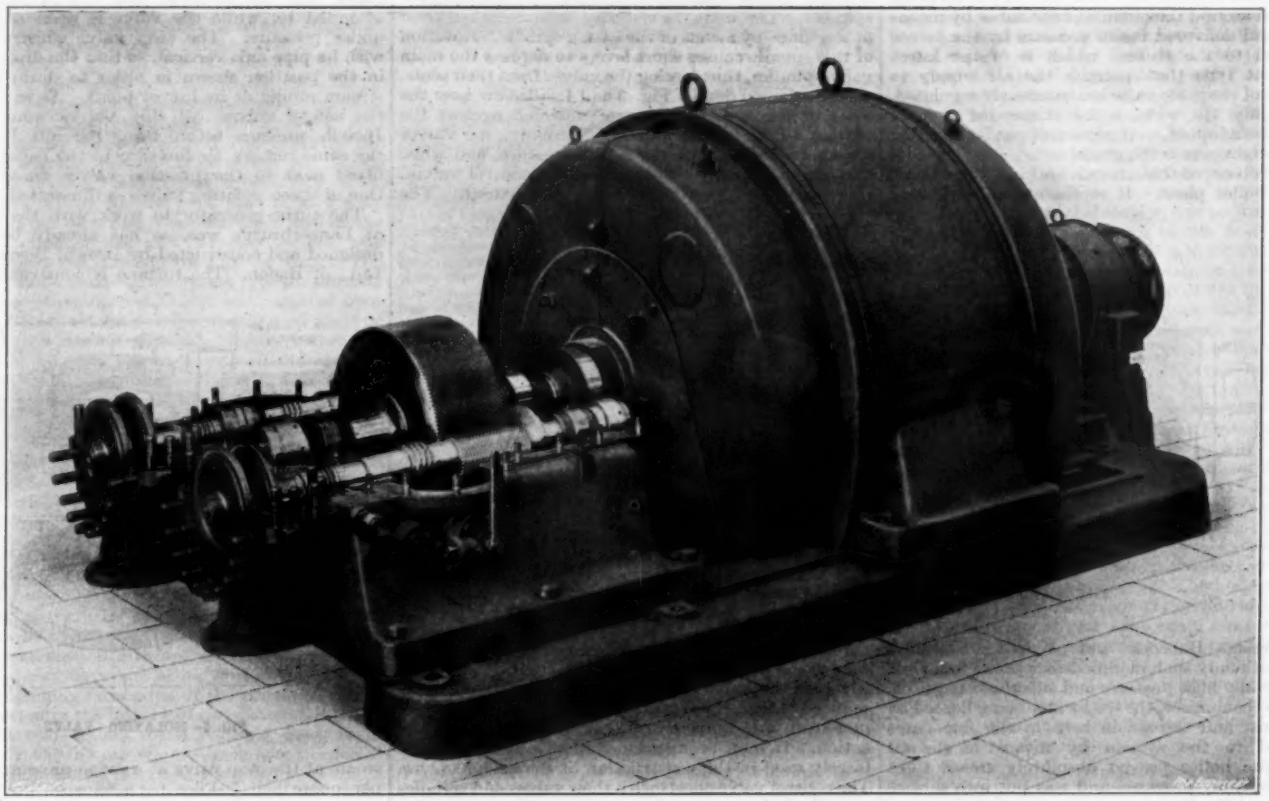


FIG. 8—2000 K.V.A. TURBO-ALTERNATOR WITH TURBINE CASINGS AND GEAR COVERS REMOVED

The general design of the turbines will be understood from the left-hand lower drawing in our Supplement, and reference to the right-hand lower drawing will make clear the kind of valve gear employed. Steam from Fig. 12 and in the drawing. Instead of single pipes being used, the connections are made by a number of "macaroni pipes," as they are called in the station, working in parallel with each other. The idea is to secure perfect flexibility, so that no expansion of the steam pipe, or distortion due to temperature or pressure, can possibly affect the

We have to thank M. Leopold Herry, the engineer and director general of the Centrales Electriques des Flandres, for permission to describe the important developments in steam engineering which have been made at Langerbrugge owing to his enterprise and courage. He will receive the congratulations of all power station engineers on the success which has attended his pioneer work in the commercial application of high-pressure steam, and the work of the various manufacturers who have made success possible is also deserving of praise. We hope at a later time to deal with the plant from a thermo-

dynamic point of view, and to inform our readers of the results obtained in daily service. The high-pressure boilers and turbine have now been running for some months in regular commercial service, and the results obtained have been extremely satisfactory.

Platinum Production in South Africa.

(By our own Correspondent in South Africa.)

TAKEN altogether, over 2000 square miles of the Transvaal have, during the past year or so, been proved to be platiniferous. That is without taking into consideration the first discovery of platinum in the Waterberg district, where only the company formed to work the original discovery is actively at work. The other companies which were quickly formed and took up properties in the same district, and indeed pegged claims in all directions from the farm Welgevonden and for a number of miles, seem to have failed to find any ore yielding platinum in quantities that would pay to work. The Waterberg occurrence differs entirely from those since discovered in the Lydenburg, Potgietersrust, and Rustenburg districts. The platinum is found there in the brecciated quartzites and felsites, which are admittedly "tricky" materials to deal with, both from the mining and metallurgical points of view, and it is generally believed that the extraction of a profitable quota of the precious metal content is by no means such an easy affair as it was believed to be a few months or so ago. Values in the ore are most erratic and jump from fractions of a pennyweight to thousands of pennyweights over short distances, necessitating exceedingly close sampling.

The writer has just completed an inspection tour of the principal platinum fields of the Transvaal—it is only in that province of the Union that platiniferous rocks have been discovered in quantities worthy of attention—and he found that the Transvaal Platinums, Ltd., the company alluded to above, has got its pilot plant, which has a capacity of 1000 tons monthly, to work, and crushing and reduction is proceeding, and it is stated that the results being obtained are satisfactory, though no declaration of an output has yet been made. The plant there is similar to that at the mine on the Onverwacht farm, which began to crush and extract in January last, and of which a description has already been furnished.* There is, however, the difference that at the Transvaal Platinums the chlorination process has found favour. No doubt this company's venture will be successful, for a considerable tonnage of payable rock has been proved. In any case, however, the Waterberg field is of lesser importance in comparison with the greater and more consistent occurrences of the Lydenburg and Potgietersrust areas.

GEOLOGICAL FEATURES.

It will be useful to enumerate here the essential geological features and characteristics of the field about to be dealt with.

Waterberg District.—Brecciated quartz and felsite lodes and cross lodes. Values exceedingly erratic and varying within restricted areas from blanks and traces up to hundreds of pennyweights per ton.

Lydenburg District.—(*a*) Hortonolite Dunite. Occurrences in pipes or lenses of limited lateral dimensions and as yet undefined vertical depth. In one only of these have high values been consistently obtained, namely, in the dunite occurrences on the Onverwacht farm of the Transvaal Consolidated Land and Exploration Company. Recently, however, encouraging values have been obtained in dunite occurrences on the properties of Lydenburg Platinum Areas. (*b*) In norite lodes of remarkably persistent nature extending over 60 miles from south to north, exhibiting notable consistency of values ranging from 2 dwt. to 6 dwt. over moderate widths. (*c*) In association with chrome iron ore; values relatively unimportant.

Potgietersrust District.—In pyroxenite bodies extending over a belt no less than 30 miles from south to north, ore bodies of great width, *i.e.*, up to 300ft., values ranging from 4 dwt. to several ounces per ton, with an average value in the region of 5 dwt. to 6 dwt., over not less than 30ft. of lode.

Rustenburg District.—(*a*) In chromite; values generally low, *i.e.*, 2 dwt. (*b*) In norite bodies of great width, but of low grade (about 2 dwt.) character. (*c*) In Pyroxenite. This is a recent discovery, but, according to the writer's observations, the economic characteristics are in some sections comparable with those observed in the Potgietersrust field.

WILDCAT MINES.

Since the discovery of platinum in the Transvaal over fifty companies with a nominal capital of something like £6,000,000 have been formed. A number of them were floated on the strength of options obtained on farms which were somewhere near where actual discoveries of the metal had been made, or were believed to have the same reefs running through them. A number of them have already gone into liquidation and some others are merely hanging on to the ground they have acquired in the hope that another boom will come which will enable them to float the properties and sell out to the trustful public. Probably one may reduce the number of companies which, at the present time, have done sufficient development to demonstrate that their properties possess sufficient quantities of payable ore to justify their being recognised as established platinum propositions to about half a score. These concerns have large capital, have done a great amount of development work, including the sinking of vertical shafts to considerable depths, cutting of scores of trenches of lengths from 50ft. up to 500ft., and carried well down into the ore bodies, winzes, adits, together with much driving from the foot of each shaft, &c. Having exhaustively proved the payability of the ore bodies and the possession of great quantities of it, they are pushing forward with the erection of plants for the crushing and reduction of the ore. In all these cases the directors have, for their mining, assaying, metallurgical, and chemical staffs, the cream of the Rand. In practically every instance the platinum companies comprise most of the great gold mining groups, and the staffs and laboratories, &c., of these groups are available in solving all the problems connected with the mining of the ore and the extraction of the platinum and allied metals. In addition, each company has a geologist of eminence and with long experience of the mining fields and geology of South Africa, who conducts his geological survey side by side with the progress of development of the ground held by the company. Among these may be mentioned Dr. Mellor, Dr. Hans Merensky, Dr. Reinecke, and Dr. Reuning, while Dr. P. A. Wagner, of the Union Government Geological Survey, has been constantly on the various fields and has given the results of his investigations at some length.

THE LYDENBURG FIELD.

It is not intended to deal here with all the fields, but merely to give an idea of a couple of the largest and most developed. Taking the Lydenburg field first, it is not necessary to deal at any length with the operations of the Onverwacht mine. This unique occurrence, which is situated on land belonging to the Transvaal Consolidated Land and Exploration Company, has just been floated as Onverwacht Platinum, Ltd. The directors are Mr. W. H. A. Laurence (chairman), Sir Abe Bailey, Sir Julius Jeppe, Mr. E. C. Izod, Mr. A. W. Rogers, and Sir Evelyn Wallers.

As has been previously stated, the occurrence at Onverwacht is in a pipe of hortonolite-dunite which at the surface is about 50ft. in diameter. From the surface to a depth of 200ft., the yield, according to close sampling and assaying, ran over an ounce to the ton of ore; below that level there was for a time a fall, and at the 250ft. level the yield was 7 dwt. per ton. It speedily recovered, however, from there on, and now, when near to 300ft. in depth, there is an average value of 18 dwt. platinoid per ton of 2000 lb. The quantity recovered for January was 260 oz. and for February 454 oz., the yield being about 14 dwt. to the ton, the recovery being about 75 per cent. For March 856 tons of ore yielded 252 oz. of platinoids. The fall in the yield was caused by the operations during the month largely consisting of work to determine the exact limits of the pipe with its payable ore. Outside it the values are almost at once exceedingly low and quite unpayable. The result of this trimming up of the edges was that the ore milled unavoidably contained rock from outside the pay zone. It is believed that mining operations may be carried down to great depths in payable ore, especially as there is no lessening as yet in the size of the pipe.

LYDENBURG PLATINUM AREAS.

In the same field are the properties of the Lydenburg Platinum Areas. This company has a nominal capital of £1,600,000. There is a number of farms in the company's possession, giving an enormous area, several of them being over 10,000 acres, but work is concentrated upon Maandagshoek, Mooihoek Driekop and Dwarsriver. The platinum deposits here occur in at least two distinct main horizons of the zone of norite rock within the complex. This rock is a variety of gabbro, a plutonic or deep-seated rock, which has solidified below the surface. The lower horizon, which lies between two layers of rock, rich in chromite, contains segregations, isolated lenses and schlieren, otherwise streaks of olivine rock rich in iron and called hortonolite dunite, in which the platinum of the lower horizon is found.

Pilot treatment plants of 50 to 100 tons per day capacity are being erected on Dwarsriver and Maandagshoek; that on Dwarsriver will begin early in May, as erection is already completed. This plant will be the first to work on norite rock. In this property, which is far to the south of the others belonging to the company, the reef outcrops on the hillside and rises for several miles, and then slowly sinks. A good road with narrow-gauge railway has been made along the hillside, and will serve to convey the ore to the crushing plant. The values are mostly round 3 dwt. Some of the pyroxenite occurrences are, however, opening out very well, and in the vicinity of one trench a sampled value of 6·6 over 80in. was obtained, and at another trench a similar occurrence gave 4·5 dwt. over 72in. The plant is so arranged that there is a gravity flow right through from crusher to reduction plant.

The plant upon Maandagshoek is to treat also the ore from Mooihoek and Driekop, and for that purpose aerial railways, in the one case 3 miles and in the other 3½ miles in length, are being erected. All the main power plant, both engine and producer, are in position, and the aerials are about completed. The plant will be in operation about the end of June. The equipment consists of R.B. disc crushers with ball mill. The final processes are not yet quite decided upon, though the Minerals Separation processes are favoured.

WATERBERG FIELD.

On the Waterberg field the only company working is the Transvaal Platinum, Ltd., which has the property on which the original discovery was made, and other farms through which the ore body runs, the total extent being about 15,000 acres. The lode here is formed in a fault fissure in felsite formation and consists of breccia of reddish felsite, cemented together by reticulated veins of quartz, and containing hematite which is frequently of the specular variety; another minor constituent is bright green chromitic chlorite. Frequently the lode is filled with massive quartz. The platinum is closely associated with the hematite, but is erratic in occurrence. It has been traced for some 30 miles, but only the one company has found ore in sufficient quantity or value to justify the erection of a mill. The platinum values have proved most irregular, "nil" or "trace" assays being in some instances followed by assays going up to 2000 dwt. to the ton. The system of open working or quarrying has continued to give satisfactory results, and at the starting of the mill, towards the end of March last, about 10,000 tons of ore reserves were at grass, the average value being 10.3 dwt. per ton. A particularly good body of ore was opened up recently, excellent results being obtained, averaging 16 dwt. The erratic nature of the occurrence precludes the framing of any reliable estimates of payable ore proved, and for the same reason no useful forecast can be made of the grade of ore the mill can supply for treatment in the reduction plant. The past year's development work, however, confirmed the technical advisers' opinion, accepted as the basis of the directors' policy, that the available data fully justified the erection of a reduction plant capable of treating up to 1000 tons of ore per month.

The Waterberg field is, however, of small importance now. It was as completely eclipsed by the discoveries in the Lydenburg district as the latter have recently been by the wonderful results obtained on the Potgietersrust platinum field. On this latter field the Potgietersrust Platinums, Ltd., is the most extensive and the more fully developed property. Its plant is expected to start early in July, and will have a capacity of 3000 tons per month. In the meantime a small experimental plant has been erected at the Government Areas Gold Mine, on the Rand, for the testing of certain metallurgical principles in connection with these ores. This plant consists of a ball mill, Wilfley concentrator and equipment for recovery of platinoid bullion or sponge by an electrochemical process.

AN ENORMOUS PROPERTY.

The extensive holdings of the company are in the Potgietersrust district, about 140 miles north of Pretoria. They extend over 30 miles and cover an area of 135,000 English acres. The platinum deposits here, as elsewhere, are generally related to the intrusive rocks, the norites, pyroxenites, &c. Practically the entire width of the valley, which is 6 miles across from east to west—the strike running north and south—consists of the well-known grey norite, except a band of ultra basic rocks of an average width of 500 yards. This belt occupies the entire eastern side of the norite, forming as it were the basal plane of the igneous complex. It consists chiefly of pyroxenite and olivine pyroxenitic rocks, largely serpentinised. This belt is generally referred to as "Pyroxenite Body." The pyroxenite body is well developed from the town of Potgietersrust to the farm Zwartfontein, a distance of about 15 miles, and situated, with the farms Sandsloot and Vaalkop, near the centre of the company's property. It rests on the underlying sedimentary deposits belonging to the Transvaal system; indeed, it penetrates there in places as indicated on the geological map. The strongest development of the pyroxenite body is in the central section of the farms Sandsloot, Vaalkop, and Southern Zwartfontein, where it attains a great width. Operations have proved that the pyroxenite, which has a width up to 800 yards, is mineralised right through, showing values from fractions of a pennyweight upwards. Higher values are concentrated along the hanging portion. This payable hanging wall portion of the vast mineralised intrusion is of corresponding width, showing values up to 7.4 dwt. over 30ft. to 50ft. The writer has taken from the mine books hundreds of assay values obtained in various shafts, winzes, trenches, drives, &c., and has also carefully examined the mine map and the Geological Survey map. The Geological Survey, it may be stated, is being conducted by Dr. Reuning, an eminent geologist, who is working abreast of the development operations, and his work has been of the greatest assistance to those carrying out the mining operations. The writer

* THE ENGINEER, March 12th, 1926.

does not, however, intend to write down strings of figures, but to state the general conclusions which all his observations led to and for which he had the strongest evidence.

DEVELOPMENT AND VALUES.

There are over some miles, 10 or so, of the central portion of the property some seven shafts, some down to 100ft., others only 30ft. From these shafts drives have been started out and crosscuts made; there are a couple of score of trenches running up to 500ft. in length and going through the overburden, which is mostly not over 3ft. to 4ft., and for 7ft. to 10ft. into the rock; there are numerous potholes going down about the same depths; bore-holes have also been put down to a depth of about 200ft., and from all these the results obtained are most satisfactory. None of the shafts give values less than an average of 4·4 dwt. One shaft indeed averages 11·8 dwt., ranging from 4·4 dwt. to 43·4 dwt. The following are entries taken at random from the books and confirmed by the writer's own sampling and panning, and by assisting in scores of fire assays:—S I., 3·00 dwt. per ton, Trench X South, 138in.; S II., 6·20 dwt. per ton, Trench X North, 372in.; S III., 5·30 dwt. per ton, Trench VII. South, 372in.; S IV., 2·80 dwt. per ton, Shaft IV., Drive South, face 42in.; S V., 7·50 dwt. per ton, Shaft IV., North Face at winze, 90in.; S VI., 4·30 dwt. per ton, Shaft IV., 25ft. depth.; No. 4 Trench, 3·8 dwt. over 100ft.; No. 6 Shaft, South Side, 4·4 dwt., over 20ft. depth; North Side, 4·4 dwt., over 20ft.; No. 6 Drive, 3·6 dwt., over 86ft. length; No. 10 Trench, North Side, 4·6 dwt., over 20ft.; Trench I., Vaalkop, 7·07 dwt., over 40ft.; Trench I., Zwartfontein, 6·50 dwt., over 28ft.

The writer agrees with those on the mine and the Geologist that the properties contain huge blocks of ore which run an average of about 3 dwt. and quite as many and probably more such blocks which will run about 6 dwt., while some can be selected that would give higher values and yet contain great quantities of such ore. The present development in the oxidised zone shows great tonnage of payable ore which can be cheaply and quickly mined by quarrying methods. In fact, it will be a number of years before it will be necessary to go down to depths which will require elaborate shafts, headgear, winding engines, &c.

The company has elected to put its crushing and reduction plant at the centre of its property and all is already on the ground. Four boilers are already in position, and a smokestack, 120ft. of brick lined with fire-brick is being erected; the engine foundations, mill, and compressor beds are ready and all the mill and reduction plant is at hand and no doubt by now in course of being erected. The total amount of money represented by the work done and the plant and machinery on the ground, together with the gas engines and winding plant at the various shafts, the portable compressors for driving the jack hammers, and the miles of light narrow-gauge railways laid, was considerably over £100,000, and at the time of the writer's visit the ox wagons were arriving in a continuous stream bringing further stores, &c. On this property some seventy to eighty Europeans and about 800 natives are employed. On all the platinum fields, the writer estimates, some 700 Europeans and about 10,000 natives are now employed.

THE RICHEST ZONE.

One cannot conclude reference to this Potgietersrust property without expressing the opinion that the richest portion is likely to turn out to be on the company's farm Tweefontein and nearer to Potgietersrust. On this farm has been discovered the latest wonder from the Bushveld platinum fields: the rare mineral sperrylite, in crystals of a size hitherto unheard of in other parts of the world, the largest so far found weighing 1·5 oz. Troy. Sperrylite is the pure arsenide of platinum and its only natural compound. Similar fissure zones rich in sperrylite have also been found on the crest of a hill 750ft. to the north of the main hill and separated from it by a shallow depression. There is a number of fissure zones heavily mineralised by copper and nickel ores; only in one winze, however, has sulphuric ore showing pyrrhotite and chalcopyrite been reached. The platinum content is of much more importance, and, as stated, phenomenal discoveries of sperrylite have been made. In the light of the knowledge gained to date, it is quite impossible to value the platinum content or to estimate the tonnage of ore in these zones. That they are rich and of great importance is obvious, but the erratic content prohibits any near approximation—assays of 1 dwt. to 5 dwt. alternate with values up to 350 dwt. per ton. The fissure zones are being opened up by means of adits, drives, and winzes, and the development is being pushed ahead as rapidly as possible further to explore these zones.

There remains to be considered the latest discovered, and one of the largest, platinum fields—that in the Rustenburg district, which has many similar characteristics to that at Potgietersrust. An amount of prospecting and development which, but for the enormous area, would be deemed very large, has already been done, and results compare favourably with those at Potgietersrust. Although personally assured that this field is destined to be second only to the Potgietersrust field, much more work requires to be done before sufficient evidence will be provided to prove the correctness of that view, and that will not be available for months to come.

The one uncertainty with regard to the proved platinum deposits in the Transvaal is what effect will the production of platinum in South Africa have when the output begins to run into a couple of hundred thousand ounces yearly. On this point there is great diversity of opinion. Some authorities declare that the price will fall to a level with that of gold, while, on the other hand, other authorities are confident that even a production of 300,000 oz. per annum in South Africa will not depress the price below £15 per ounce. This, of course, is a matter beyond the province of a mining engineer, but the writer knows for a fact that firms oversea have offered some of the platinum companies of the Transvaal a price of between £15 and £20 per ounce for a ten years' contract to supply over 100,000 oz. per annum, but stipulating for guaranteed delivery. Those connected with the industry out here who have been questioned by the writer profess to have satisfied themselves as to the probable effect on prices, and while they expect to see a fall, perhaps down to £15, they also anticipate a rapid and large increase in demand which will prevent any further fall for a number of years and may even cause the value to rise towards £20 per ounce again.

Past and Future of the Steel Industry.*

I BELIEVE it is many years since the Iron and Steel Institute elected a President not intimately associated with the actual manufacture of steel, and so unable to discourse learnedly upon the technology of the industry. Those, however, who use steel, particularly if concerned with its manipulation in a cold state, represent an important and interesting branch of the industry, and if only as a healthy exception to an otherwise desirable rule, the occasional selection of a President from among their number may be both appropriate and wise.

It occurred to me that as there are now indications that the world has made some definite progress towards a return to normality, this occasion would not be inappropriate for laying before the members of the Institute a picture of the past history of the steel industry as a matter of interest in itself, so that it may help us to form some reasoned judgment as to the prospects which the future holds in store. For this purpose, with the assistance of Mr. Lloyd, to whom I am greatly indebted, I have prepared a chart, and in this connection I desire also to express my thanks to Sir William Larke for the valuable information he has placed at my disposal.

In this chart I have set out four main curves, one representing the total of the world's production of steel, and the other three the respective annual productions of the United States, the Continent of Europe, and of Great Britain.

I had expected to find a steady development in the world's consumption of steel, but I must admit to a feeling of some amazement when the curves were finally plotted out. Measured in terms of present consumption, the total production of steel was almost insignificant up to forty years ago, and the year 1885 may be taken as marking the commencement of what may fairly be described as the "Steel Age," for which the discovery and development of the basic process was so largely responsible.

The most striking feature in the curve of the world's production of steel is the extraordinary uniformity in the rate of increase. Periodical fluctuations which must have taken place are entirely obscured in the curve plotted on bold lines, and up to 1914, instead of any inclination for the rate of increase to diminish, the curve tended continually to become more steep.

Looking at the curve, it is difficult to avoid the conclusion that had the normal development of the world not been interrupted by the Great War, the world's consumption of steel would have continued to increase at a rate not dissimilar to that previously experienced, and might to-day have exceeded 100 million tons per annum.

In addition to certain subsidiary points of interest from which useful deductions may possibly be drawn, the curves bring to the eye three other main features. The first is the disturbing effect of the war, as illustrated by the curve movement between 1913 and the present time; secondly, the extraordinary similarity of the total production of the United States and the Continent of Europe respectively during the pre-war period; and thirdly—a matter with which Great Britain is peculiarly concerned—the failure of Great Britain to maintain her position in relation to the United States and the Continent. Until the year 1890 the respective productions of Great Britain, the United States and the Continent of Europe were approximately the same. Thereafter, the production of steel in the United States and on the Continent grew with amazing rapidity, while the production of Great Britain, although increasing, increased at a rate in no way comparable with the general increase in the world's demand.

In spite of the unsatisfactory condition of the steel industry during the past few years, the curve seems to suggest that the pre-war rate of expansion of the world's consumption has been approximately restored, and encourages the hope that in the next ten years an expansion even to the extent of 30 million tons a year is not beyond the bounds of possibility, or indeed of reasonable anticipation—an expansion which would go far to solve many of the troubles from which the industry is suffering. Unfortunately, ten years is a long time, and British steel makers, at all events, are much concerned to know what proportion of that estimated increase will fall to their lot, and how soon they can hope for a demand for British steel equal to British capacity to produce.

Many, if not all, the difficulties of our great basic industries are to be attributed to an arrest for practically ten years of the normal growth in the world's demand, an arrest which unfortunately was not accompanied by an arrest in the rate of increase in instruments of production. In the case of the steel trade, and other industries vitally concerned with the supply of munitions, there was in many countries a direct stimulus to an increase in plant, and an improvement can hardly be expected until that increased capacity is absorbed.

The curve of the United States production indicates that the capacity of that country both to produce and consume continued to grow during the period of the war at approximately the pre-war rate, and the market in the United States being such a large factor in the world's demand for steel, it is manifest that the total world's demand must be greatly increased before there is any surplus demand available for the benefit of the European manufacturers.

Production on the Continent, after sinking to the depths of the post-war depression, has steadily risen, and in 1925 was but little short of the aggregate production of 1913. There is, however, a large amount of plant on the Continent still lying idle, of an estimated capacity of 10 to 15 million tons per annum, which can only be brought into operation by a corresponding increase in the world's demand.

The production of the United States in 1925 exceeded the highest level reached before the war by over 10 million tons, and to absorb this increase and to occupy the idle European plant and provide for a normal increment in the steel requirements of the United States, there must be an increase in the world's demand of at least 30 million tons, or, say, ten years' increment at the phenomenal rate of increase experienced prior to the war.

It is difficult to avoid the conclusion that even if the most optimistic anticipations are realised, the pressure of competition from the Continent during the next ten years must continue to be very severe. In this connection we must not fail to bear in mind that there are many new developments in steel manufacture in other countries of the world, and this increase in local production must diminish the share of the world's demand available to the old steel-producing nations.

Up to this point we have discussed the prospects of the steel industry, particularly from the point of view of the United States and the Continent of Europe, but we here are more intimately concerned with the well-being and future prosperity of the industry in Great Britain.

I have already drawn attention to the regrettable feature in the curves showing that from 1890 onwards Great Britain secured a negligible share in the phenomenal increase of the world's steel trade. Another regrettable feature is indicated in the closing years covered by the chart. While the world's demand, the production of the United States, and the production on the Continent showed during those two years a healthy and encouraging improvement, the production of Great Britain steadily fell, and if the suggestion is well founded that we cannot reasonably hope that the world's demand will, in less than ten years, overtake the world's capacity to produce, the present trend of British production must give rise to feelings of profound anxiety.

It is no doubt true that, owing to the depreciation of the continental exchanges, and the lag in internal values, as compared with world values, the continental manufacturers have enjoyed an artificial advantage in competing with Great Britain, both in the British home market and in the markets of the world, and that we may hope that, in the course of a year or two, this lag will disappear and Great Britain will no longer suffer from that peculiar handicap. Unfortunately, pre-war experience does not encourage us to anticipate that even under pre-war conditions—if these are to be regarded as the conditions of normality—British steel manufacturers will be able to compete with that success which present circumstances would seem to demand.

I do not think it can be denied that prior to the war the heavy competitive trade passed largely into the hands of the manufacturers on the Continent and in the United States, while such increase as was, in fact, secured by the British steel industry was rather in the direction of special lines and special qualities, and with the assistance of special conditions. Even for the home requirements of billets and sheet bars a large proportion was imported from abroad.

Clearly, with the great increase in British steel-

* Iron and Steel Institute. Presidential address by Sir William Peter Rylands, June 3rd. Abridged.

making plant, it is now essential that the British steel manufacturers endeavour to secure a greater share of the heavy competitive trade, since it is doubtful whether any increase in the world's demand which can be anticipated during the next ten years will be accompanied by a sufficient increase in the special trades where Great Britain enjoys some peculiar advantage. Otherwise, without a serious reduction in productive capacity, the conditions of the British steel industry may be difficult for a considerable number of years to come.

These reflections invite consideration as to the reason why Great Britain failed to maintain her share in the general expansion of the world's trade, and after maintaining her position for twenty years up to 1890, thereafter was left behind in the race. Great Britain was the cradle of the steel industry. Some of the most revolutionary advances in technique originated in Great Britain. She had bountiful supplies of cheap coal, and although the Minette ore fields were of great assistance to the German industry, much of their steel was made from ore derived from other sources, presenting no particular advantage.

No doubt the United States derived great advantage from their immense and expanding home market; but, as I have pointed out, it is a notable feature that the increase in production on the Continent kept pace step by step with the corresponding increase in the United States, and it is not easy to appreciate the exact advantage enjoyed by the Continent of Europe over those who conduct the industry in this country.

Examining once more the history of the steel industry, it will be noted that its early development following on the introduction of the basic process was accompanied by a serious trade depression—a depression experienced not only in Great Britain, but also shared by the United States and the Continent. It will be observed that between the years 1885–1887 the price of Cleveland iron reached the lowest figure ever recorded. Two important factors developed both in the United States and on the Continent approximately at that time: the first was the definite adoption by both the United States and Germany of a tariff policy designed to protect the home market; the second, arising, without doubt, out of the depressed condition of the industry, was the development of a high degree of internal organisation of the trade in both those countries. At the depth of the depression the Carnegie Group was formed in the United States, followed later by the United States Steel Corporation, while in Germany syndicates were created for controlling the coal, pig iron, and finally steel, by means of the Stahlwerks Verband.

It would not be appropriate to lay any stress upon the desirability of an import duty, or to draw any deduction as to the advantage which accrued from that policy to the industry in the United States and in Germany. This is a matter of political controversy upon which different views are held, and the fact that that policy was followed in the countries adopting it by success, accompanied by relative failure in Great Britain, may have been merely a *post hoc* and not a *propter hoc* phenomenon. We are on safer ground if we argue that organisation was the responsible and dominant factor.

There can be no doubt that the development of steel production in America was closely associated with the internal organisation of the industry, and the corresponding improvement of organisation in Germany was similarly associated with corresponding successful development. In few, if any, other industries are the costs of production so profoundly affected by large-scale output and continuous operation as in the industries of steel and coal, and I am strongly convinced that the remarkable success of Germany and the United States in securing the lion's share of the increasing world's demand for steel is to be attributed to organisation directly aimed at securing that result. As an illustration, on a visit I paid to Germany in the year 1912, I was informed that the cost of producing mild steel billets in Westphalia exceeded 80 marks per ton, approximating very closely to the cost of manufacture in Great Britain. Those same billets were delivered to buyers in this country at a delivered price of under £4 per ton, and, having regard to the cost of carriage, it was manifestly impossible for the British manufacturers to compete.

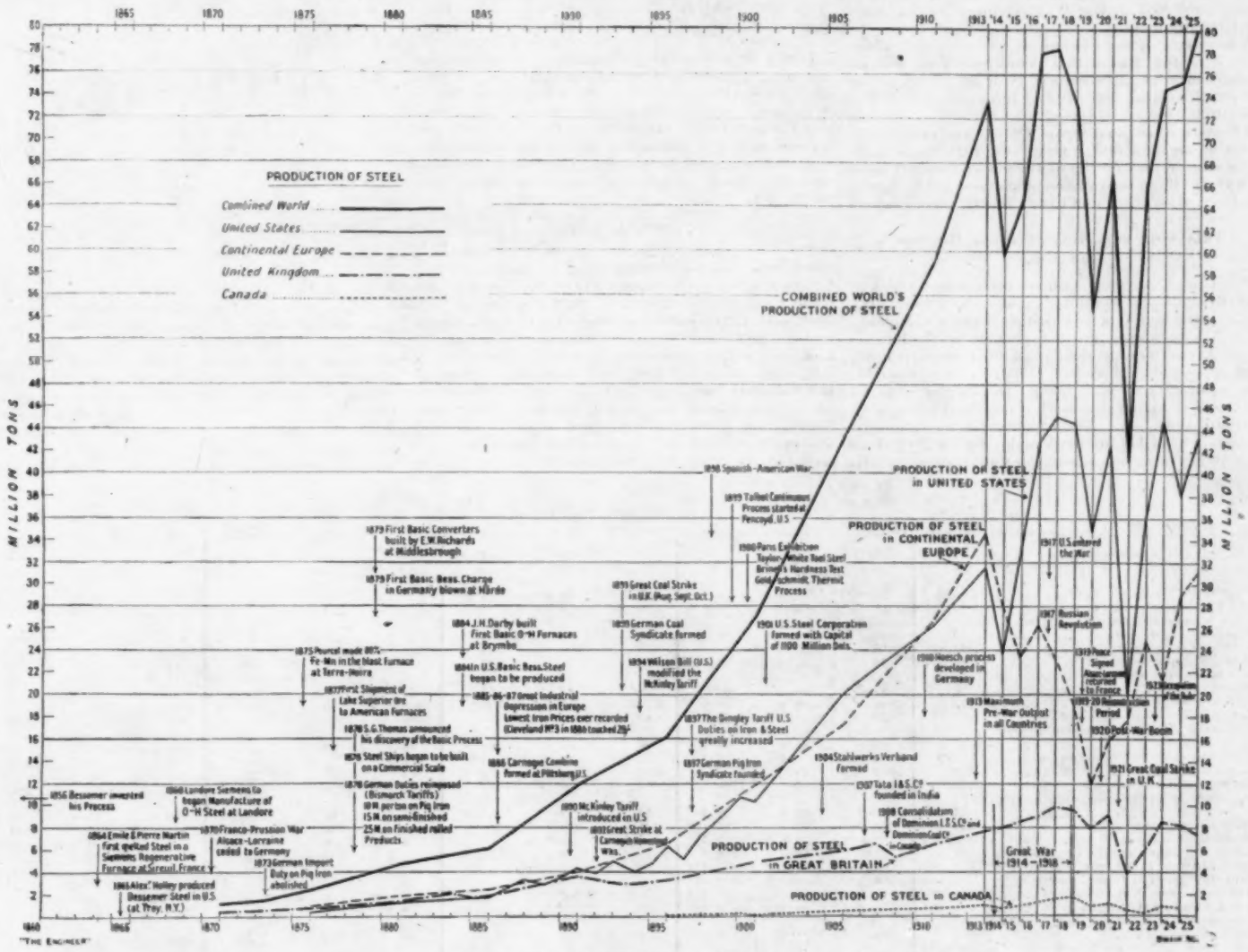
No doubt the pursuit of special qualities is not entirely compatible with the policy of large and standardised production, and as long as the capacity of Great Britain can be satisfied by special business of this kind, and the manufacturers concerned are content, a valuable and important industry can be maintained; but if, as appears now to be essential, Great Britain is to secure a greater share of the world's steel trade, it may be suggested that a different policy is imperatively demanded.

The commercial greatness of Great Britain was largely founded upon her production of coal and steel, and if that industrial position is to be maintained, I suggest that the problem should be approached from the broadest point of view in the interests of the country as a whole. Some national responsibility attaches to the steel makers of this country. It is not enough that a few steel works should be conducted with success. It is rather a matter of great national concern that the industry should secure the greatest possible share of the world's steel trade and give the utmost employment to the industrial workers of the country, and in this respect as I read the chart which I am venturing to submit to you, the prospect for the British steel industry during the next ten years affords grounds for anxiety.

A further reflection, not altogether fanciful, is suggested by the amazing rate of increase in the world's consumption of steel. It is difficult to believe that a cheaper substitute for coal could ever be discovered for the manufacture of pig iron, and while we are assured that the coal resources of this country may be expected to last for some hundreds of years, that is a comparatively short period when measured in terms of geological time. Even, however, if we need not concern ourselves with anxieties which lie in the dim and distant future, the cost both of coal and of ore must increase under the law of diminishing returns. Within the recollection of many of us, slack was regularly sold by collieries at 3s. per ton at the pit, and forty years ago the price of Cleveland pig iron was so low as 32s. per ton; yet in spite of improvements in technique, the real costs of both coal and pig iron have greatly increased. It would appear certain that this tendency must continue, and the real cost of steel in this country, with the exhaustion of home supplies of ore and the inevitable increase in the cost of coal, will steadily rise. It is equally likely that certain other parts of the world more favourably situated in regard to ore and steel will enjoy an increasing economic advantage.

Practical steel makers will no doubt be better able to judge how far the cost of home supplies of ore will be affected during the next ten or twenty years, but taking a broad view, this reflection, so far as it is of substance, emphasises the importance of scientific organisation of the industry, both on the technical and commercial side.

The Iron and Steel Institute has done much in the past to assist in technical development, but it seems to me that still more intimate co-operation is now necessary, and that the vast world's consumption of iron and steel demands correspondingly large-scale productions, the co-ordination of technical knowledge, and the most efficient application of every technical


PRODUCTION OF STEEL
Combined World
United States
Continental Europe
United Kingdom
Canada
COMBINED WORLD'S PRODUCTION OF STEEL
PRODUCTION OF STEEL in UNITED STATES
PRODUCTION OF STEEL in CONTINENTAL EUROPE
PRODUCTION OF STEEL in GREAT BRITAIN
PRODUCTION OF STEEL in CANADA
MILLION TONS
1856 Bessemer invented his Process
1864 Emile & Pierre Martin first melted Steel in a Siemens Regenerative Furnace at Sireuil, France
1865 Alex. Holley produced Bessemer Steel in U.S. (at Troy, N.Y.)
1868 London Siemens Co. began Manufacture of O-H Steel at Landore
1870 Franco-Prussian War
Alsace-Lorraine ceded to Germany
1873 German Import Duty on Pig Iron abolished
1875 Purvis made 80% Fe-Mn in the blast Furnace at Terre-Noire
1877 First Shipment of Lake Superior Ore to American Furnaces
1878 S. G. Thomas announced his discovery of the Basic Process
1879 First Basic Converters built by E. W. Richards at Middlesbrough
1879 First Basic Bess. Charge in Germany blown at Hörde
1884 J. H. Darby built First Basic O-H Furnaces at Brymbo
1884 In U.S. Basic Bess. Steel began to be produced
1885-86-87 Great Industrial Depression in Europe
Lowest Iron Prices ever recorded (Cleveland No 3 in 1886 touched 29/-)
1886 Carnegie Combine formed at Pittsburg U.S.
1890 McKinley Tariff introduced in U.S.
1892 Great Strike at Carnegie Homestead Works
1894 Wilson Bill (U.S.) modified the McKinley Tariff
1895 German Coal Syndicate formed
1897 The Dingley Tariff U.S. Duties on Iron & Steel greatly increased
1897 German Pig Iron Syndicate founded
1898 Spanish-American War
1899 Talbot Continuous Process started at Pencoyd, U.S.
1900 Paris Exhibition Taylor-White Tool Steel
Brinell's Hardness Test
Goldschmidt Thermit Process
1901 U.S. Steel Corporation formed with Capital of 1100 Million Dols.
1904 Stahlwerks Verband formed
1907 Tata I & S. Co. founded in India
1908 Consolidation of Dominion I. & S. Co. and Dominion Coal Co. in Canada
1908 Haesch process developed in Germany
1913 Maximum Pre-War Output in all Countries
1914-1918 Great War
1917 U.S. entered the War
1917 Russian Revolution
1919 Peace Signed
Alsace-Lorraine returned to France
1919-20 Reconstruction Period
1920 Post-War Boom
1921 Great Coal Strike in U.K.
1923 Occupation of the Ruhr
"THE ENGINEER"

CURVES SHOWING PRODUCTION OF STEEL

advance if a steel-producing nation is to hold its position in the race.

The manufacturers in the United States of America and on the Continent seem to have realised this, and have set an example which might wisely be followed in this country if the steel trade of Great Britain is to overcome the pressing difficulties of the next ten years, to which I have invited your attention, and of the more remote period when we may gradually lose some of the national advantages which we at present enjoy.

Marine Oil Engine Trials Committee

THE fourth report of the Marine Oil Engine Trials Committee dealing with the land and sea tests carried out on the engine of the motor vessel British Aviator was to have been presented and discussed at a joint meeting of the Institutions of Mechanical Engineers and Naval Architects which was fixed for Friday, May 7th, at the home of the first-named body. In view of the emergency conditions then in force, the President of the Institution of Mechanical Engineers decided that the meeting should be cancelled and the report published in the "Proceedings" along with a written discussion.

A summary of the Committee's first report, which dealt with the Richardson-Beardmore-Tosi engines of the motor vessel Sycamore, will be found in our issue of November 28th, 1924. In our issue of March 27th, 1925, the second report of the Committee on the Scott-Still-engined vessel Dolius was dealt with, whilst in our issue of January 15th, 1926, an account of the third report on the motor vessel Pacific Trader with Doxford opposed-piston oil engines will be found. We summarise the Committee's fourth report below.

TRIALS OF THE MOTOR VESSEL BRITISH AVIATOR.

The British Aviator is an oil tank vessel and was built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the British Tanker Company, Ltd. The following are her general particulars:—Length between perpendiculars, 440ft.; length overall, 445ft.; moulded breadth, 57ft.; mean draught, 26ft. 6¾in. When fully loaded the displacement of the vessel is 14,705 tons with a deadweight capacity of 10,040 tons. She was designed for an estimated service speed of 11½ knots when developing 2700 shaft horse-power at 86 revolutions per minute on one shaft. Being an oil tanker, the propelling machinery is placed right aft. A description of the ship and her engines was given in our issue of November 21st, 1924. The rated output of 2700 shaft horse-power at 86 revolutions per minute is developed in six cylinders acting on the two-stroke cycle with opposed pistons working on six cranks. The engine, built under the Camellaird-Fullagar patents, is double-acting in the sense that each crank receives two impulses in each revolution, but combustion only takes place between the pair of pistons in a given cylinder. Air injection for the fuel is used.

The propeller of the British Aviator is made of smooth manganese bronze and has four separate blades, which are bolted to the boss. It is driven direct from the engine. Over the tips of the blade it measures 18ft. 1½in. in diameter and it has a uniform blade pitch of 15ft.

From the report of the Committee we extract the following weights of machinery, &c., in the engine-room:—

TABLE I.—*Weight of Machinery in the Engine-room.*

Part.	Weight, tons.
Main engine: complete with all pipes and fittings, including thrust block and propeller, but excluding fly-wheel	373
Fly-wheel	5
Shafting and stern gear	32
Boilers, condenser, oil fuel burning plant, steam and steam exhaust pipes	83
Auxiliaries, pipes and fittings—	
Fuel oil system	15
Cooling water system	10
Lubricating oil system	12
Gas exhaust system	10
Pumping system (bilge, ballast and general service pumps)	23
Electric generator system	35
Fittings on board: Funnel complete, engine-room floors, ventilators, gratings, workshop, lifting gear, tools and outfit	55
Air reservoirs	27
Spares: main engine and auxiliaries, including spare propeller and tail end shaft	25
Total	705
Water in system and in reserve	11
Water in boilers (two)	28
Water in reserve feed tank	60
Lubricating oil in system and in reserve	18
Total	117
Total running weight	822

It may be noted that the weight of the main engine, including the fly-wheel, works out at 313 lb. per rated shaft horse-power, as compared with 382 lb. for the Sycamore's engines, 260 lb. for those of the Dolius, and 278 lb. for those of the Pacific Trader. The report states that the cylinders had an average bore of 23in. with an average stroke of 36in. The clearance volume was 1901 cubic inches and the compression ratio 13·24 to 1.

TESTS ASHORE.

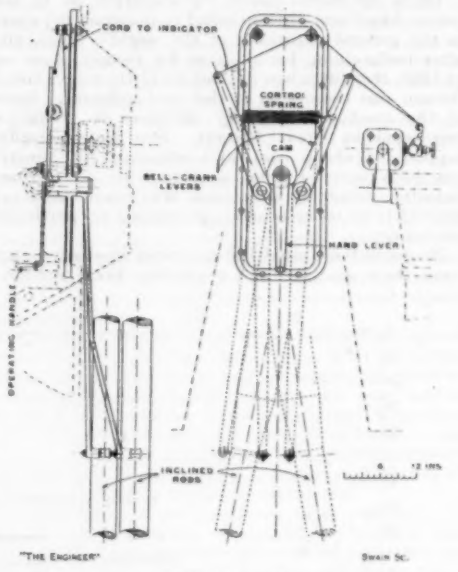
The shore trials of the engine were conducted in the marine engine erecting shop of Palmer's Shipbuilding and Iron Company, Ltd., Jarrow-on-Tyne, from April 28th to May 2nd, 1924. As in the tests dealt with in the previous three reports, the approximate propeller law—torque = constant × (r.p.m.)²—was used to determine the speeds corresponding to full, three-quarters, half, and one-quarter torque, the value of the constant being deduced from the rated horse-power and speed, namely, 2700 brake horse-power at 86 revolutions per minute. Each test was conducted at the speed so calculated, and was repeated at speeds 12 revolutions per minute above and below the calculated value. These speeds, which are referred to as A, B, and C respectively, are set forth in the following Table II. The twelve tests covered by this table were conducted with British Petroleum Diesel oil and the results are embodied in Table III. Test No. 10 was an extra test with the engine developing power in excess of its rating. Additional tests for determining the power absorbed in friction in the engine and to determine the slowest speed at which the engine could be run were also made, to which reference will be made later.

TABLE II.—*Schedule of Loads and Speeds, Test Numbers 1 to 13.*

Applied external load.			Speed (r.p.m.)		
			A.	B.	C.
Nominal.	Torque.	Nearest brake load.	Calculated from propeller law.	High speed.	Low speed.
Full torque	165,000	11,000	86	98	74
¾ torque	123,750	8,250	75	87	63
½ torque	82,500	5,500	61	73	49
¼ torque	41,250	2,750	43	55	31

Generally the equipment employed for conducting the shore tests closely followed that described in the previous reports. We need only briefly refer to the indicating arrangements and drive.

The indicators employed on the power cylinders were of the Maihak external spring type and were driven by the rig shown in the accompanying engraving. The drum of the indicator on any particular cylinder was actuated through one or other of a pair of bell-crank levers, the lower ends of which were oscillated by the motion of the inclined rods which connect the lower piston in one cylinder with the upper piston in the adjacent cylinder. Either of the bell-crank levers could be released so as to allow the roller at its lower end to come into contact with the corresponding inclined rod by means of the cam on the hand lever shown in the engraving. The same movement gripped the adjacent bell-crank lever, the upper end of which provided a fixed point for the control springs. One actuating gear drove the indicators on both the cylinders which comprised a unit. In respect of one cylinder it was therefore possible to obtain a pair of diagrams in one of which the abscissæ were derived from the motion of the lower piston and in the other from the upper piston. Thus the instantaneous pressure for a given angular position of the crank was obtained from the crank position in the case of the lower piston, whereas in the case of the diagram which was derived from the motion of the upper piston the corresponding instantaneous pressure was determined by the angular position of the adjacent crank. The ratio of the connecting-rod to the crank was 4·5 and the average motion of both pistons in one cylinder was simple harmonic.



INDICATOR RIG

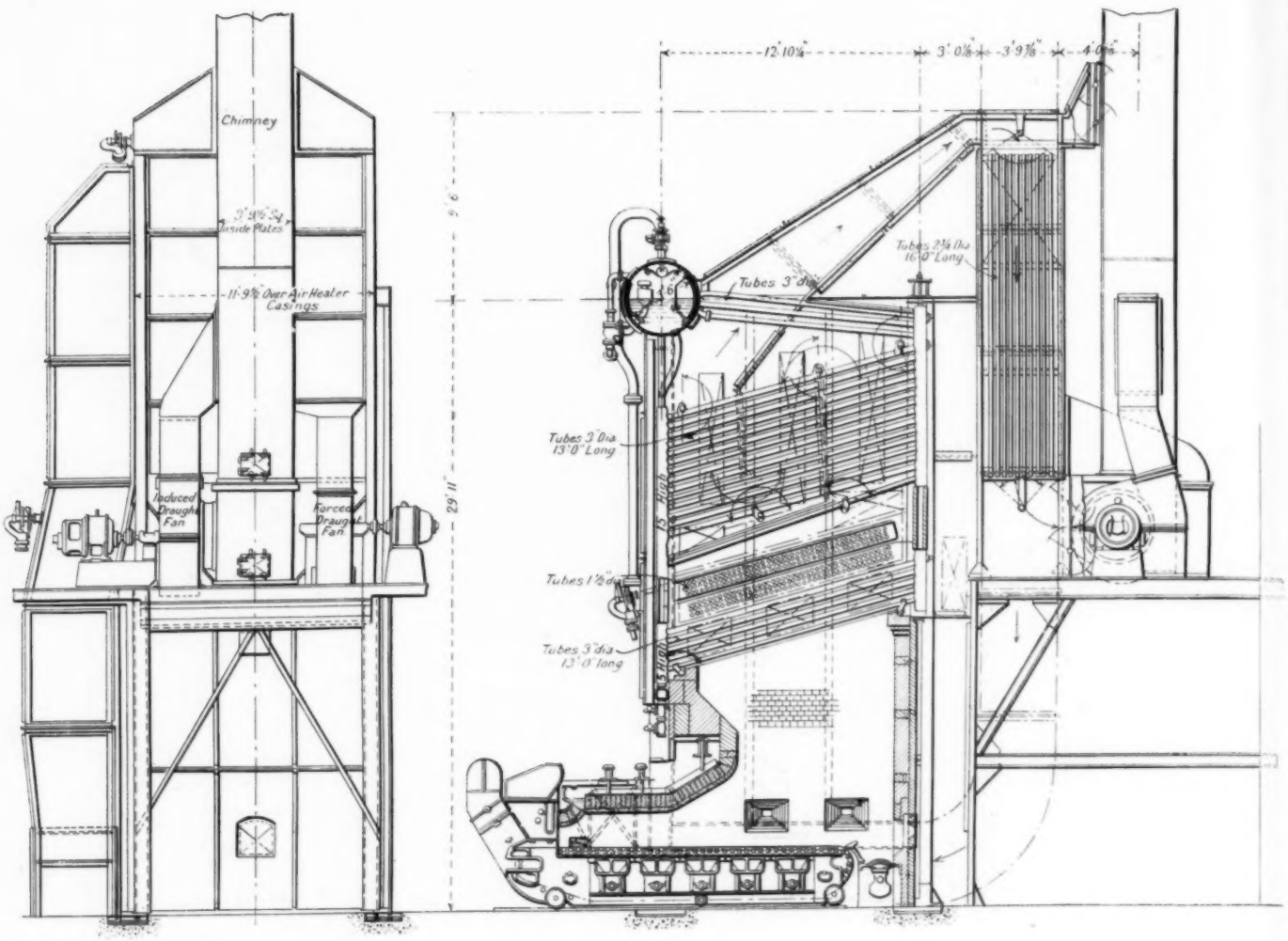
The fuel oil passing to the engine was measured by direct weighing on a new Pooley tank type lever

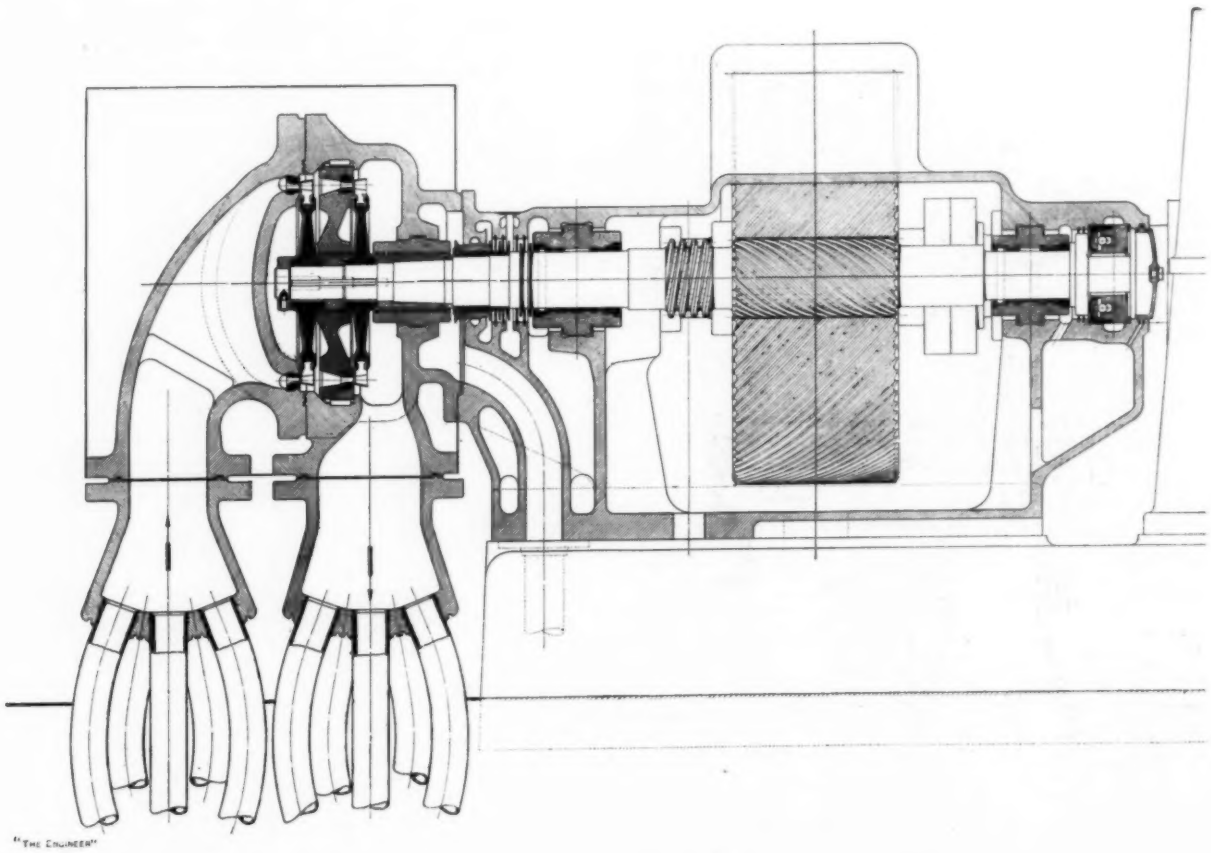
TABLE III.—*Shore Trials.*

Test number:	A 10	B 7	A 9	C 8	B 4	A 6	C 5	B 1	A 3	C 2	B 11	A 12	C 13
Average speed, r.p.m.	88·9	98·8	87·5	72·0	87·4	73·0	63·0	73·7	62·2	49·8	53·9	40·5	34·2
Load on brake, lb.*	12·35	11·12	11·06	11·14	8·27	8·43	8·25	5·35	5·81	5·59	3·14	3·09	2·96
Pressure in cylinders, lb. per sq. in.—													
At end of compression	500	500	495	490	475	480	470	470	455	460	445	430	420
Maximum during firing	645	615	635	690	610	635	640	595	610	605	470	465	460
At end of expansion	36	34	32	31	25	26	24	18	18	18	12	12	12
Mean indicated pressure, average all cylinders	93	87	86	84	68	69	66	49	52	48	32	29	27
Indicated horse-power	3770	3860	3360	2740	2720	2280	1900	1660	1420	1100	780	530	420
Indicated horse-power corrected	3810	3820	3410	2900	2640	2280	1950	1560	1400	1100	730	570	490
M.I.P. from I.H.P. (corrected), lb. per sq. in.	94·7	85·4	86·1	88·9	66·7	69·0	68·3	46·8	49·7	48·8	29·9	31·1	31·7
Scavenge air pressure, lb. per sq. in.	2·5	3·0	2·4	1·7	2·3	1·6	1·2	1·5	1·2	0·7	0·8	0·5	0·3
Total scavenge I.H.P.	152	201	145	83	135	81	52	73	50	25	29	12	8
Brake horse-power	3135	3140	2760	2290	2065	1760	1485	1165	1030	795	485	360	290
Brake mean effective pressure, lb. per sq. in.	77·9	70·3	69·8	70·4	52·2	53·1	52·0	34·9	36·7	35·2	19·8	19·5	18·7
Friction horse-power	332	273	310	348	237	264	259	164	180	162	147	143	141
Mechanical efficiency	0·823	0·819	0·806	0·792	0·783	0·773	0·762	0·747	0·732	0·719	0·654	0·620	0·561
Quantity of fuel per minute corrected, lb.	21·5	21·6	18·5	15·3	13·9	12·0	10·3	8·4	7·6	6·1	4·2	3·4	3·0
Weight of fuel per B.H.P. per hour, lb.	0·412	0·413	0·402	0·401	0·404	0·409	0·416	0·433	0·443	0·461	0·520	0·567	0·621
Weight of fuel per I.H.P. per hour, lb.	0·339	0·339	0·325	0·317	0·316	0·316	0·317	0·323	0·326	0·332	0·345	0·358	0·368
Thermal efficiency, B.H.P. basis	0·324	0·324	0·332	0·333	0·331	0·326	0·320	0·309	0·301	0·291	0·257	0·236	0·216
Thermal efficiency, I.H.P. basis	0·393	0·393	0·409	0·421	0·421	0·422	0·420	0·414	0·409	0·402	0·386	0·372	0·365
Temperature of exhaust gas (deg. Fah.) at end of manifold	551	530	524	476	378	387	360	286	284	272	230	215	211
Cooling water, gallons per hour*—													
Passing through jackets	13·6	10·3	11·2	11·7	11·8	9·4	11·2	11·2	11·1	10·9	9·9	7·9	5·7
Passing through pistons	8·8	6·5	7·7	7·6	8·1	6·8	7·6	10·4	8·6	7·4	6·3	5·5	4·9
Heat rejec'd in cool'g water, B.Th.U. p.m.*													
From jackets	68·7	64·9	62·5	54·8	40·6	39·3	36·6	37·1	23·1	27·6	19·5	11·6	7·6
From pistons	32·1	30·6	31·9	32·2	24·4	23·6	21·0	27·6	10·6	12·6	10·5	7·1	6·2

* In units of 1000.

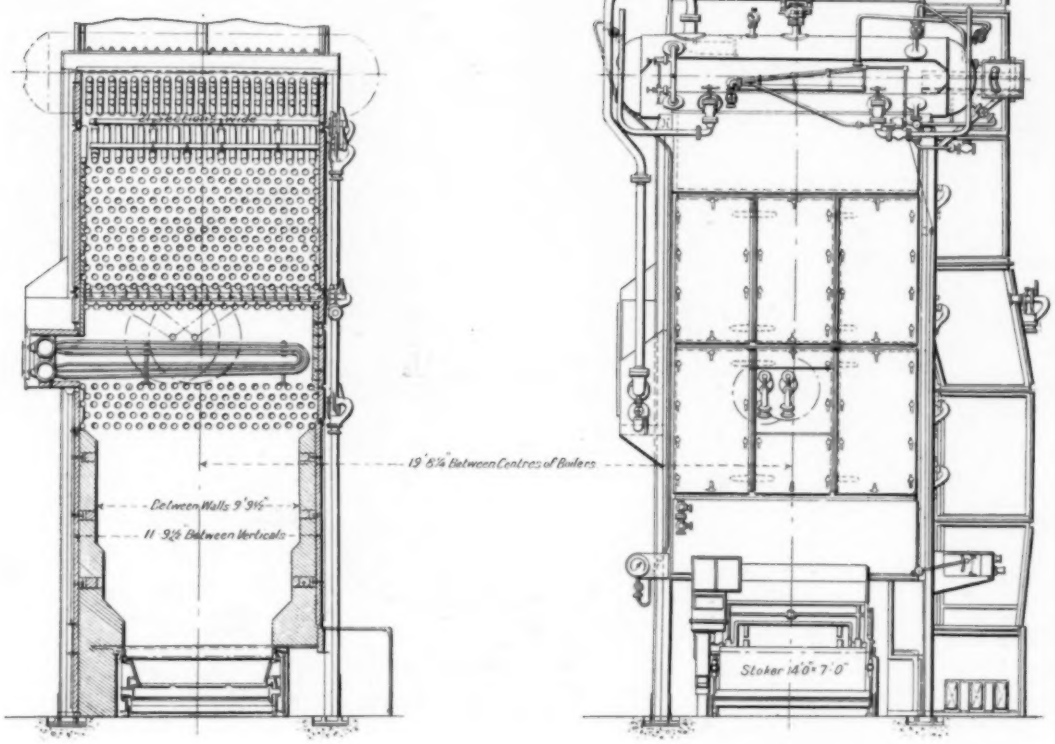
LANGERBRUGGE POWER STATION, EL

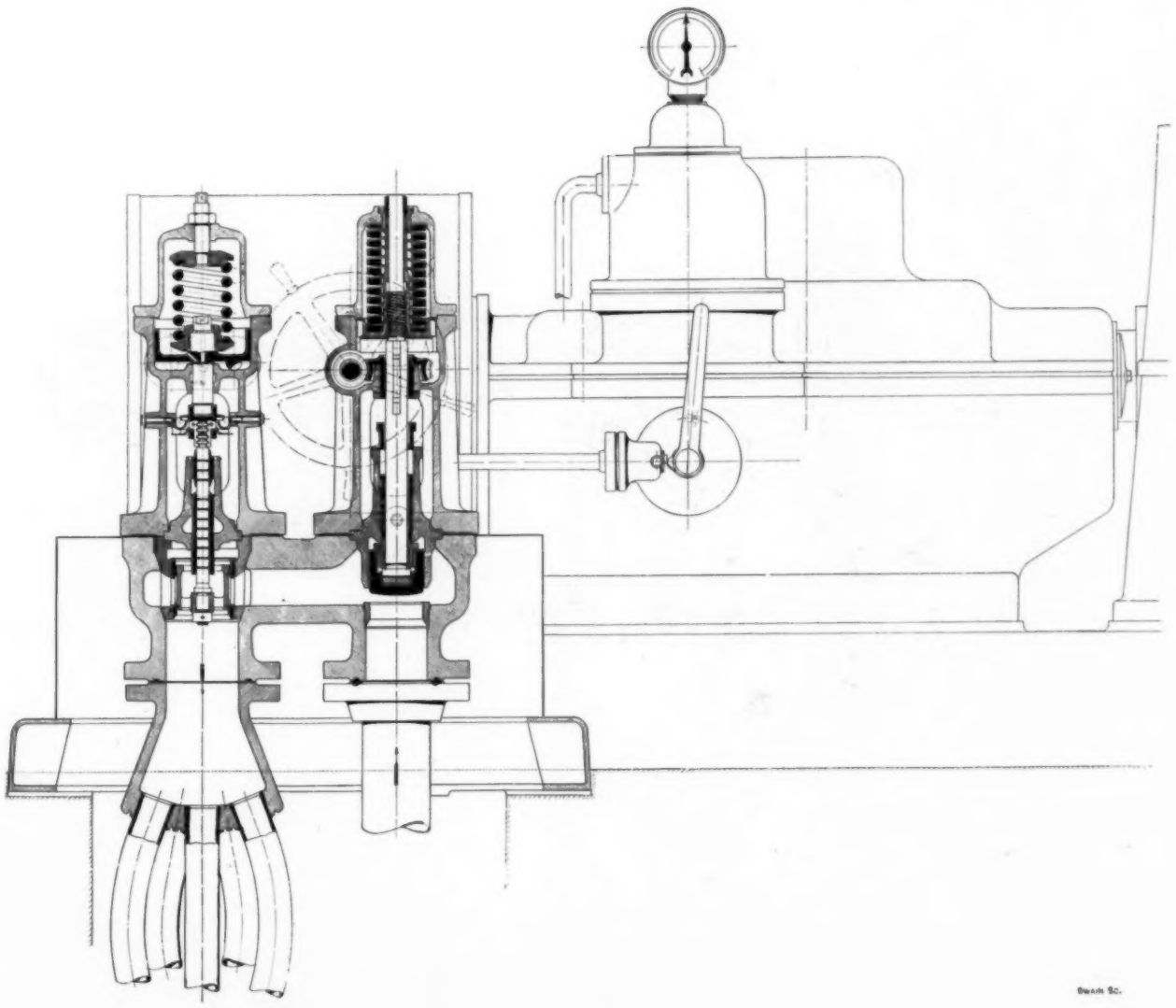




"The Engineer"

Boiler Heating Surface	4765 Sq Ft	442·7 M²
Superheater do do.	1173 „ „	100·0 M²
Air Heater do. do.	4900 „ „	455·4 M²
Grate Area	98 „ „	9·1 M²
Load on Safety Valve	796 Lb per □"	56 Kg. per C. M²





Swain Sc.

UNIV. OF WISCONSIN

weighing machine. An analysis of the samples of fuel oil taken during the shore tests showed that the British Petroleum Diesel oil as sampled had an average gross calorific value of 19,118 B.Th.U. per pound and a specific gravity of 0·892 at 60 deg. Fah. At sea, using the same oil fuel, the calorific value was 19,130 B.Th.U., with a specific gravity of 0·895.

Results of Tests Ashore.

The results of the shore tests are set forth in the original report in eight tables and thirteen diagrams. We summarise the numerical data in Table III., while in Table IV. we reproduce the thermal balance sheets in full. The fuel consumption and indicated horse-powers as observed were plotted on the basis of brake horse-power, and fair curves drawn between the points obtained. In Table III. the figures given for made to measure the torque or thrust direct by torsion meter or thrust meter.

Starting Air, Manœuvring, and Slow-speed Trials.

With the engine in a normal condition as when starting from cold and with an initial pressure of 1010 lb. in only half—that is, sixteen of the starting air reservoirs—it was found possible to obtain thirty-five starts before the receiver pressure fell to 205 lb. at the thirty-sixth order of the telegraph, at which point the engine refused to start. The lowest pressure at which the engine was started was 225 lb. and the average volume of free air used per start was 443 cubic feet. With all the receivers connected seventy starts could be made.

The manœuvring trial was carried out following the

Table IV.—*Thermal Balance Sheets (all quantities of 1000 B.Th.U. per minute).*

Test number:	A 10	B 7	A 9	C 8	B 4	A 6	C 5	B 1	A 3	C 2	B 11	A 12	C 13
To heat in fuel	411·0	412·0	353·0	292·0	266·0	229·0	197·0	160·0	145·0	116·0	80·0	65·0	57·0
By thermal equivalent of—													
Brake horse-power	133·0	133·2	117·0	97·2	87·6	74·7	63·0	49·4	43·7	33·7	20·5	15·3	12·3
Air compressor horse-power	8·1	8·7	8·3	7·6	8·6	7·4	6·5	6·7	5·9	5·0	2·9	2·3	2·2
Scavenge horse-power	6·5	8·5	6·1	3·5	5·7	3·4	2·2	3·1	2·1	1·1	1·2	0·5	0·3
By heat rejected from—													
Jackets	68·7	64·9	62·5	54·8	40·6	39·3	36·6	37·1	23·1	27·6	19·5	11·6	7·6
Pistons	32·1	30·6	31·9	32·2	24·4	23·6	21·0	27·6	10·6	12·6	10·5	7·1	6·2
Guides	1·0	2·9	2·4	2·1	0·9	2·1	1·7	—	1·0	0·2	1·7	1·0	0·8
By heat carried away in exhaust gases, &c.	161·6	163·2	124·8	94·6	98·2	78·5	66·0	36·1	58·6	35·8	23·7	27·2	27·6
	411·0	412·0	353·0	292·0	266·0	229·0	197·0	160·0	145·0	116·0	80·0	65·0	57·0

these quantities are the faired values so obtained. A similar process of fairing was used in connection with the mechanical efficiency values. Pending a decision from the Committee on the tabulation of results from heat engine and boiler trials, no figure is given in the report for the ideal thermal efficiency of the standard of comparison.

Additional Tests Ashore.

With regard to the additional tests which were carried out, the particulars given for Test 10 cover an output 16 per cent. above the full rated power of the engine. The trial conditions were calculated from the "propeller law" used in the compilation of Table II. A slow-running test was carried out after the conclusion of Test 13. The slowest speed maintained over a period of five minutes was 22·8 revolutions per measured mile runs on the first day. With the manœuvring air compressor running and one-half the air reservoirs connected twenty-five orders were given from the bridge and the time intervals between the receipt of an order in the engine-room and the attainment of the corresponding engine speed were recorded on the tachometer along with the fall in pressure in the air receiver. From stop to dead slow ahead—43 revolutions per minute—required 10 sec. to execute and the pressure in the receiver fell from 1010 lb. to 990 lb. From full speed ahead—84 revolutions per minute—to full speed astern—75 revolutions per minute—took 23 sec., and the drop in air pressure was from 720 lb. to 660 lb. With the engine running slow from ahead to astern and astern to ahead took 12 sec. and 14 sec. respectively. The times given were those required merely to reset the engine, but in

Table V.—*Sea Trials of M.V. British Aviator.*

Run number	9	10	11	12	5	6	7	8	3	4	1	2	13	14
Ship's speed, knots	11·65	11·61	11·79	11·63	9·99	10·45	10·19	10·35	8·27	9·18	5·73	6·33	10·30	11·33
Engine speed, r.p.m.	82·6	80·8	80·5	83·1	74·5	73·5	75·5	73·8	62·4	62·5	42·5	43·9	72·8	82·9
Average mean indicated pressure, lb. per sq. in.	95	91	91	96	77	77	78	76	59	59	36	36	73	92
Indicated horse-power, observed	3,550	3,330	3,320	3,610	2,600	2,560	2,660	2,540	1,670	1,670	690	720	2,410	3,460
I.H.P. corrected	3,530	3,330	3,360	3,610	2,580	2,550	2,660	2,550	1,650	1,680	700	700	2,400	3,470
M.I.P. from corrected I.H.P.	94·4	91·0	92·2	96·0	76·5	76·7	78·0	76·3	58·4	59·3	36·4	35·2	72·8	92·5
Mechanical efficiency corresponding to corrected M.I.P.	82·0	81·5	81·8	82·4	79·0	79·1	79·2	79·0	75·5	75·6	68·7	68·0	78·2	81·8
"Brake" horse-power	2,890	2,710	2,750	2,970	2,040	2,020	2,110	2,020	1,250	1,270	480	480	1,880	2,840
Corresponding torque, lb.-ft.	183,900	176,200	179,500	187,800	143,800	144,400	146,800	143,800	105,200	106,800	59,400	57,400	135,600	180,000
Fuel per hour, observed, lb.	1,198	1,142	1,170	1,257	843	836	884	844	514	541	238	235	772	1,198

minute. On the following day a determination was made of the mechanical efficiency by the brake method, in which the fuel and air injection are cut off each cylinder in turn and the reduction noted in the brake load required to preserve the speed unchanged. The mechanical efficiency so determined was 83·8 per cent.

Sea Trials.

The British Aviator ran fourteen sea speed and fuel consumption trials, and in addition a starting air trial, a manœuvring trial, and a slow-speed test were carried out. The following speed runs:—

4 runs (Nos. 9 to 12) at nominal engine speed of 86 r.p.m.
4 runs (Nos. 5 to 8) at nominal engine speed of 75 r.p.m.
2 runs (Nos. 3 and 4) at nominal engine speed of 61 r.p.m.
2 runs (Nos. 1 and 2) at nominal engine speed of 43 r.p.m.

were carried out off Whitley Bay and two four-hour fuel consumption trials were made between the mouth of the Tyne and the Farne Islands. On both the trial days, August 11th and 12th, 1924, the ship's draught was 25ft. 10in. forward and 26ft. 11in. aft. These figures compare with the builders' draught of 26ft. 6¾in. forward and a like amount aft when the vessel is in the fully loaded condition. The fuel used was British Petroleum Diesel oil of approximately the same physical characteristics as that which was used for the shore trials. During the measured mile runs it was possible to determine the indicated horse-power and the fuel consumption, and particulars of the results obtained are summarised in Table V—columns 1–12 together with the results of the two four-hour fuel consumption trials—columns 13 and 14. The torque was computed from the shaft horse-power, which was calculated from the indicated horse-power developed at sea and the mechanical efficiency as measured during the shore trials. No attempt was two cases a minute was allowed to elapse between the orders so that the ship could gather way.

For the slow-speed trials readings were taken over ten minutes at each half-minute. The lowest speed recorded over the whole time was 28·9 revolutions per minute and the lowest over a five minutes' interval 28·4 revolutions. During the slow-speed test the pressure in the air injection vessel fell continuously from 700 lb. to 600 lb. per square inch.

Obituary.

R. SANFORD RILEY.

We regret to have to record the death at the early age of fifty-one of the distinguished American engineer, Mr. R. Sanford Riley, who died at his house in Worcester, Massachusetts, on May 7th. A Canadian by birth—he was born in Hamilton, Ontario, in 1874—he graduated in mechanical engineering from Worcester Polytechnic in 1896, and, after gaining experience in locomotive and marine engineering he served for some time as an engineer officer in the United States Navy.

From 1905 to 1911 he was connected with the American Ship Windlass Company, of Providence, R.I., after which he organised the Sanford Riley Stoker Company, to develop and manufacture the automatic stoker bearing his name. Success was speedily achieved, and the Riley stoker is found not only in the United States, but in power plants all over the world. Mr. Riley was also a director of the Norton Company.

During the war his experience was placed at the disposal of the United States Government, and he was appointed chief of the Performance Division of the Emergency Fleet Corporation, immediately under Mr. Charles Schwab.

Mr. Riley was well known to many engineers in England and represented the American Society of Mechanical Engineers at the Watt Centenary Celebrations at Birmingham in 1919. Only recently he was asked to accept nomination to the presidency of the Eastern Section of the Society. Of striking personal appearance, Mr. Riley impressed those he came into contact with as a man of exceptional ability and kindness of heart, and he will be missed, not only in engineering circles, but in the social life of Worcester, where he lived.

GEORGES MOILLIET.

A message has been received by cable from Japan by Boving and Co., Ltd., that Mr. Georges Moilliet, the manager of that firm's Tokyo office, succumbed to typhoid on May 17th. His loss will be deeply felt by many friends in all parts of the world.

Yorkshire is the home of the Moilliets in this country, although Mr. Georges Moilliet was of French-Swiss origin, and was educated at the "Polytechnicum" at Zurich. He very soon made his mark as a thorough and sound engineer of outstanding capabilities, and became associated with Mr. Boving in 1898. He specialised in water power plants, and during his period of training he was in the employ of Escher, Wyss and Co., of Zurich, Switzerland, and of the A.B. Karlstads Mekaniska Verkstad, Kristinehamn, Sweden. In 1908 he took up the position of residential engineer of Boving and Co., in Japan, where, although he represented a firm of manufacturers his advice on hydraulic power plants was widely sought, so high did his reputation for impartiality stand. In fact, Mr. Moilliet's character had that sterling quality which made everyone who came into contact with him hold him in the highest esteem and affection.

A DISTILLING PLANT FOR THE RED SEA.

Just before the recent general strike, the Mirrlees Watson Company, Ltd., of Glasgow, shipped to the port of Jeddah, on the Arabian Red Sea coast, a sextuple-effect fresh-water distilling plant. The plant will be used to produce 150 tons of pure distilled water per twenty-four hours from the extremely salt water of the Red Sea. The water so produced will be used for drinking, and this plant will be the second of its type to be erected in the port of Jeddah, which is the landing port for pilgrims on their way to the holy city of Mecca. A feature of the order was the short time in which the plant was built and despatched. The boiler, the tanks and the structural steel work required for the buildings to house the plant were all despatched within seven days of the receipt of the order. The combined pumping plant, consisting of the circulating and vacuum pump, together with the auxiliary pumps for distiller feed and brine extraction, also the fresh water and boiler feed pumps, were built and run under steam within seventeen days from the date of the order. In four weeks the main plant and staging, comprising six vessels each, with a heating surface of 337 square feet, was erected. One week afterwards it was entirely dismantled, packed and shipped, the total time for the job being five weeks from receipt of order until the plant was loaded on board ship and had left the Clyde.

The Mirrlees Watson Company, Ltd., has supplied no less than fourteen sets of distilling plants to one or other of the Red Sea coasts. These plants vary in output from 30 tons up to 350 tons of fresh water produced per day of twenty-four hours. Three of the larger 350-ton plants are in operation on the African side of the Red Sea. A high efficiency is obtained, from 36 lb. to 40 lb. of gained water per pound of fuel consumed being produced.

Weathering of stone is usually considered to be due to frost action or the chemical action of the elements. If water did not find admittance to the interior of the stone, the effect of freezing temperatures would be almost negligible. An examination of old stone buildings will usually show the greatest weathering effect where water has had the best chance to penetrate. Projecting courses of porous stone, as, for instance, the cornice and coping, take up water which soaks downward through several courses of stone below. Such parts of a building suffer severely, not alone from frost action, but also from the more severe disintegration effects of efflorescence.

An Improved Thread Milling Machine.

WE were recently invited to inspect at the establishment of Buck and Hickman, Ltd., Whitechapel-road, E. 1, a new model of thread milling machine produced by the Pratt and Whitney Company, of Hartford, Conn. The machine, the first of its type to reach this country, accommodates diameters up to 10in. and lengths between centres of 24in. It is also made in a longer form to take 60in. between centres with the same maximum diameter. In design it differs considerably from the same makers' 12in. machine, which it has been built to replace.

The machine is of the single disc cutter type in contradistinction to the more familiar multiple or hob-cutter form. The single cutter thread miller is suitable for cutting square, vee or other threads without rounded crests. For milling threads of the Whitworth pattern a cutter formed with rounded fillets on each face is used. In general, the threads milled on the machine illustrated are of the square or vee type; on ordinary Whitworth threads the special features of the machine render its use profitable in special circumstances, as, for example, those met with in screwing very tough steels.

The machine requires three main power movements, namely, the rotation of the cutter at cutting speed, the rotation of the work at feeding speed, and the traverse of the cutter longitudinally at such a speed that it moves through one pitch distance while the work is making one complete revolution. These three movements are controlled by three separate change gear trains. For the cutter a range of five spindle speeds is provided, the range extending from 29·3 to 96·2 revolutions per minute. For the work seventeen speeds, extending from 0·04 to 0·635 revolution per minute, are arranged. At the outset the cutter begins, at either end of the work, at the full depth of the thread and thereafter, preserved at this depth, completes the thread at one traverse. The maximum depth to which the work may be cut is $1^{9}/_{16}$in.

The cutter spindle is mounted in a head—see Fig. 2—which is arranged to swivel about a horizontal axis, lying at right angles to the work. This adjustment is provided to enable the cutter to be set at an angle corresponding with the angle of the thread to be cut. In addition, it permits keyways and splines to be milled when the cutter spindle is set vertically and the rotation of the work is stopped. With the cutter spindle horizontal and the traverse of the saddle suppressed, the machine is capable of milling annular grooves.

The machine is driven either by a single belt from a countershaft, or, as shown in Fig. 4, by a $7\frac{1}{2}$ horse-power constant speed motor running at 1750 revolutions per minute, mounted on a hinged plate. By adjusting this plate the tension in the belt, whereby power is transmitted from the motor to the main driving shaft at the rear of the bed, may be varied. The belt pulley on the main driving shaft is completely enclosed in a guard, and contains a friction clutch which is operated from a handle—A, Fig. 1—at the front of the headstock.

From the main driving shaft power is taken to the cutter spindle, as shown in Fig. 6, by way of bevel wheels and change-speed spur gearing, the final drive being through helical pinions and wheels of considerable width. The second bevel pinion is mounted collinearly with the axis, about which the cutter head is rotated to suit the angle of the thread to be cut, so that the adjustment may be accommodated by the rolling of the bevel wheel round the bevel pinion. To facilitate the angular setting of the cutter a worm and worm wheel and an indexing scale are provided on the head. The head as a whole is mounted to slide crosswise on a carriage and is adjusted thereon to regulate the depth of cut by means of a hand wheel fitted with a graduated scale and a positive stop. The transverse movement of the cutter head on its carriage is accommodated by means of a spline on the shaft carrying the second bevel pinion. A rear view of the cutter head and carriage is given in Fig. 3. The lever shown at B in this view controls the direction of rotation of the cutter, reversal being necessary in order that the work may be threaded at will either from the headstock or the tailstock end. A subsidiary feature of the arrangement is the centralised oiling system for lubricating the principal members of the cutter drive. When the work is of such dimensions as to make it liable to spring under the force of the cut, a steadying attachment embracing about three-quarters of the work circumference is mounted on the carriage in front of the cutter.

The longitudinal traverse of the cutter carriage at the correct rate to give the required lead to the screw being cut is derived from a lead screw, cut with two threads per inch. This lead screw is driven from the headstock spindle by change wheels lying below the guard C—Fig. 4. By means of these change wheels threads can be cut with leads extending from $^{1}/_{12}$in. to 48in. A thread with a pitch of 4ft., it may be noted, can hardly be described as a screw, and is more correctly a spiral spline. A hand traverse operated by the handle D—Fig. 1—is provided, as is a

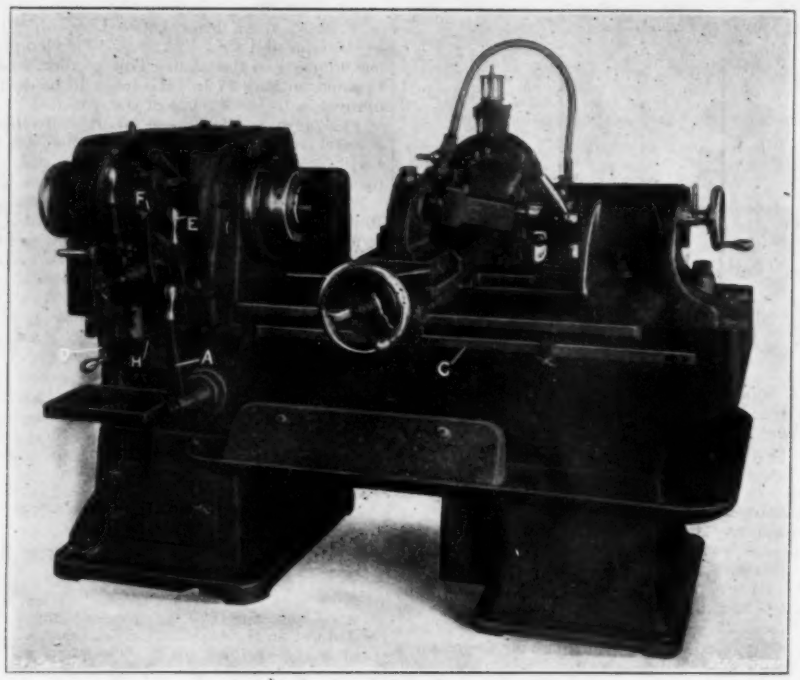


FIG. 1—SINGLE DISC CUTTER THREAD MILLING MACHINE

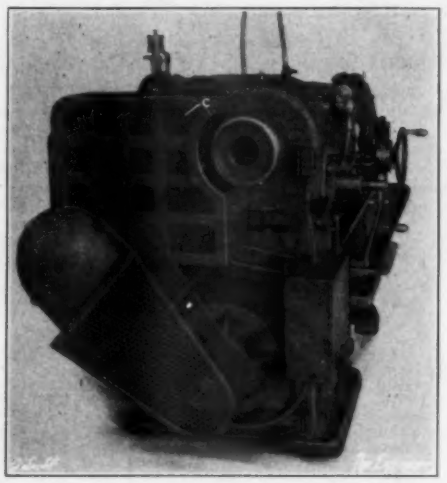


FIG. 4—MOTOR DRIVE

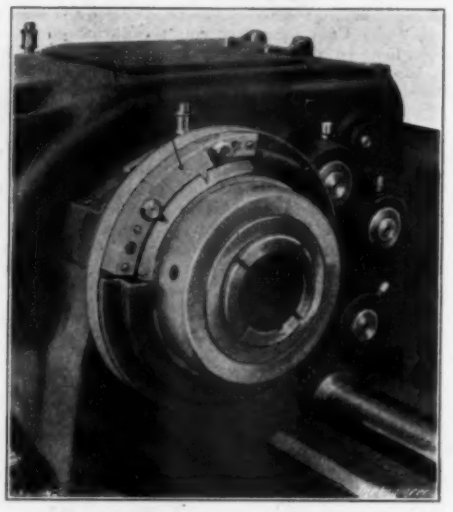


FIG. 5—INDEXING PAWL ON COLLET

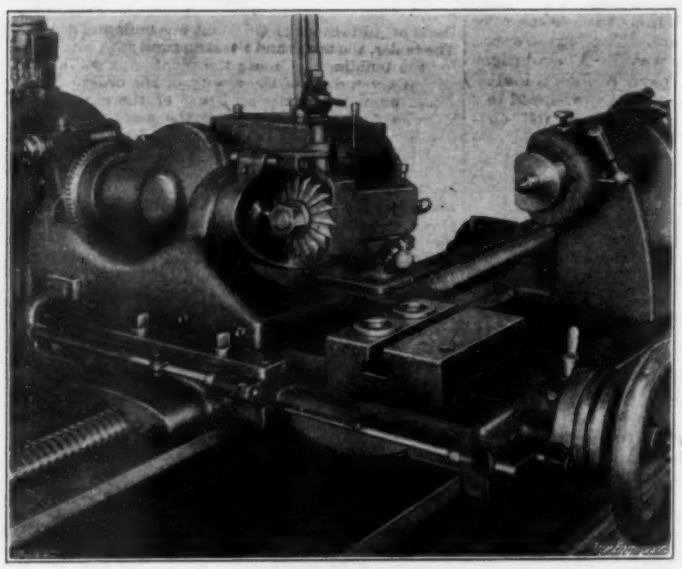


FIG. 2—CUTTER, CUTTER HEAD AND SADDLE

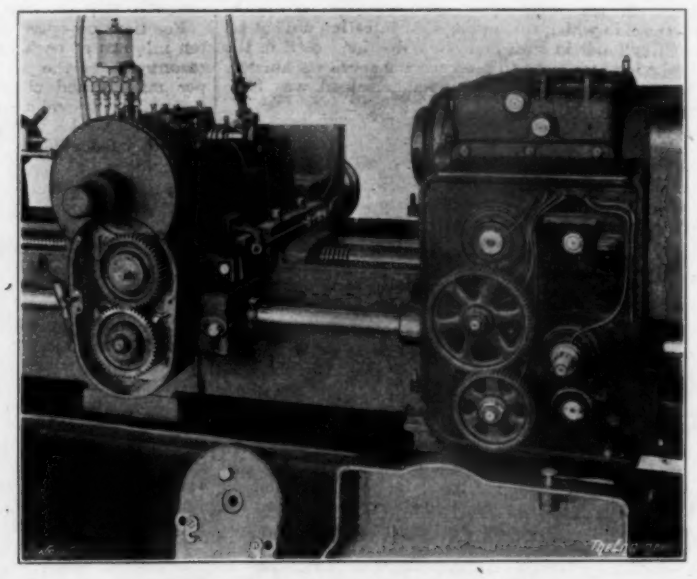


FIG. 3—CUTTER SPINDLE AND WORK SPINDLE GEAR BOXES

quick power traverse, controlled by the handle E in the same engraving, for returning the cutter carriage to the starting point after the cutter has been backed away from the work.

The third main power motion is the rotary feed of the work. This motion is derived from the main driving shaft by way of a change wheel gear-box, shown with its cover removed, towards the right of Fig. 3. As has already been stated, a range of seventeen rates of feed is available. As the lead screw is driven from the work spindle, any change in the rotary feed of the work produces a proportionate change in the longitudinal traversing speed of the cutter, and therefore does not affect the pitch of the thread being cut, as determined by the change wheels at C—Fig. 4. Further, as the cutter and the work spindle are driven through separate gear trains, the cutter speed and the rotary feed of the work can be selected quite independently of each other. The rotary feed is engaged and disengaged by means of a clutch operated by the handle F—Fig. 1. A knock-off bar G, fitted with adjustable dogs, is provided, which, moved in one direction, stops the rotary feed of the work and the traverse of the cutter, and, moved in the other, stops the rapid return motion of the cutter carriage.

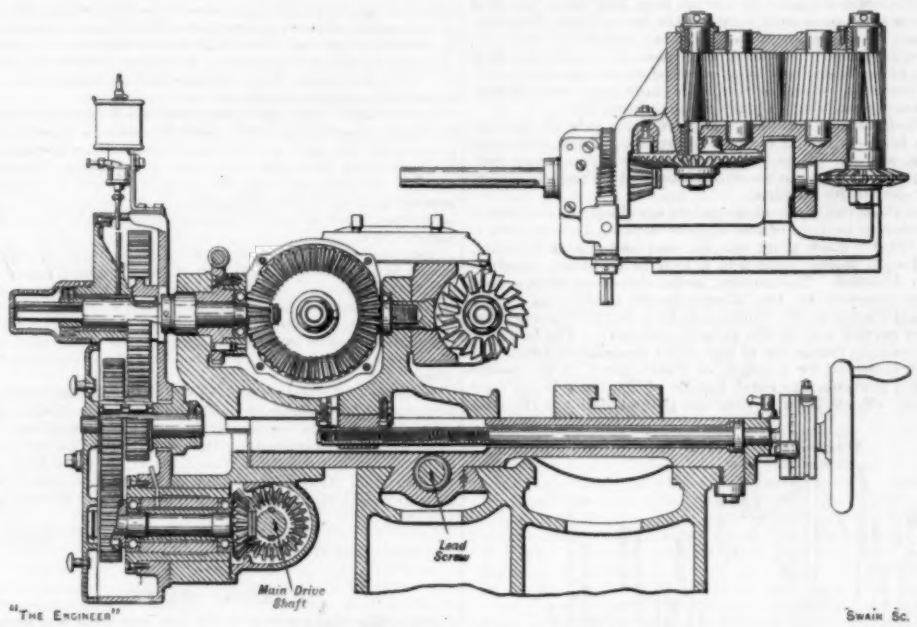


FIG. 6—DETAILS OF CUTTER HEAD AND SADDLE

As the thread can at will be cut from either end of the work, the knock-off bar has to be arranged to reverse the actions produced by its movements. This reversal is effected by moving the link H from the bottom to the top of the plate, to which its left-hand end is shown attached.

The work is held between the back centre and a collet at the end of the headstock spindle. The collet has a capacity of 3¼in. As shown in Fig. 5, provision is made for cutting multiple-start threads. The means provided consist of a pawl J mounted on the flange of the spindle and engaging through a tooth with a notch in the collet body. There are twelve of these notches, so that multiple threads with two, three, four, six or twelve starts may be cut.

Particulars of two tests made with the machine have been given us. The material cut was mild steel. Using a 5in. diameter carbon steel cutter running at 39·5 revolutions per minute, and taking a cut 1¾in. deep with a feed of 1·84in. per minute, the metal removed while cutting a thread of 2in. pitch was 3·36 cubic inches per minute, and the net power absorbed by the machine 8·55 horse-power. With a 5in. diameter high-speed cutter running at 76 revolutions per minute a 2in. pitch thread was cut. The depth of cut was $^{15}/_{16}$in., and the feed 4·82in. per minute. In this test 4·15 cubic inches of metal were removed per minute, and the net horse-power absorbed was 6·45 horse-power.

South African Engineering Notes.

Port Elizabeth Harbour Extension.

Over a year ago Mr. M. F. G. Wilson, M. Inst. C.E., and Colonel G. F. Nicholson, M. Inst. C.E., the latter Consulting Engineer to the Union of South Africa Government regarding the ports of the country, were called upon by the Government to formulate a scheme of harbour improvement at Port Elizabeth. These two experts having recommended certain alternative schemes, the Government appointed a Commission consisting of Messrs. J. G. van der Horst (chairman), F. C. Sturrock and P. Serton, to investigate and report as to whether the carrying out of the whole or any portion of the scheme of harbour improvement at Port Elizabeth detailed in the report of the two engineers was justified by (1) the agricultural and industrial position, actual and potential, within the hinterland served by Port Elizabeth; (2) the existing industries and trade and industrial prospects of Port Elizabeth; (3) the volume of goods landed and expected to be landed at Port Elizabeth in transit for inland destinations, having due regard to the existing facilities and to the extent to which Port Elizabeth is already adequately served thereby. On March 30th the report of the Commission was issued and it emphatically declares that the increasing industrial activities, agricultural production, especially in maize, stock and fruit, warrant the carrying out of a large harbour scheme. The report shows that, even at present, the facilities are utterly inadequate and that before the harbour scheme can be carried out there will be an increase of traffic, for which they consider an estimate of 10 per cent. to be conservative. For these reasons they recommend what is termed plan No. 2, which will give an enclosed harbour and will comprise the north pier and 4000ft. of quay. Should it be decided for financial reasons to carry out plan No. 1, comprising the north pier with outer quay of 2000ft., it must be clearly understood, they say, that it will be only the first part of the complete works. Plan No. 1 in itself does not entirely meet the requirements of the anticipated traffic, and combined with the cost of lighterage it will, in the long run, be no cheaper than plan No. 2. Plan No. 3, the report states, includes plan No. 2 with the addition of certain reclaimed land and the construction of further jetties. In all the plans are included the complete equipment of the quays with cranes, railway track, sheds, &c., but no provision is made for a grain elevator, cold storage works, &c., because such installations would presumably be self-supporting. The estimates, which may vary 15 per cent. either way in respect of the pier and quays, are as follows:—Plan No. 1, £1,437,000; plan No. 2, £1,899,000; plan No. 3, £3,802,000. The following amounts, which may be taken as fairly accurate, must be added to all these plans:—Breakwater, £1,600,000; dredgers, £40,000; new and larger tug, £50,000; weighbridges and minor expenditure, £50,000. The total cost of the completed harbour would therefore be:—Plan No. 1, £3,177,000; plan No. 2, £3,639,000; plan No. 3, £5,542,000. It may be added, with reference to the Commission's report, that the breakwater is at present in course of construction, and at the end of January its overall length laid in concrete was 1912ft. and the total length at the base 1959ft. When completed it will be 8500ft. in length. At present Algoa Bay is an open roadstead with excellent holding ground where vessels ride with absolute safety. The harbour is naturally protected except for about seven points of the compass and ships lying in the roadstead can discharge their cargoes with rapidity and safety into lighters. There are three iron jetties equipped with hydraulic cranes varying in capacity from 2 to 7 tons and one electric crane capable of dealing with lifts up to 20 tons. Sailing ships of 800 tons and steamers of about 1200 tons can be berthed at the South Jetty. At the Dom Pedro Jetty vessels of about 2000 tons can be accommodated. There is a small slipway capable of carrying craft of 400 tons deadweight. The average total tonnage handled at the port at present is about 50,000 tons per month.

In making his Railway Budget speech on April 1st, the Minister of Railways announced that, on the lines of the Harbour Commission's recommendations, a survey is to be carried out as a preliminary step to a possible big development scheme for Port Elizabeth harbour.

Union Railway Budget.

The Union (South Africa) Railway Budget was introduced on April 1st. The total revenue for 1925–26—year ended March 31st, 1926—showed a revenue of £27,766,269, an expenditure of £27,093,282, and a surplus of £672,987 for the year. Much of the increased earnings of the railway was due to the huge quantity of maize—about 1,100,000 tons—which was exported during the year. During the current financial year 1926–27 it is estimated that, owing mainly to there being no maize for export, due to the failure of the crop, the earnings will be £7000 per week less than in the past year. Revenue is estimated at £27,224,791 and expenditure at £27,310,572, giving a deficit of £85,781. Important factors in the ensuing year are the opening of 252 miles of new lines which have been constructed and will be opened for traffic, also the working of the 205 miles of railway acquired from the New Cape Central Railway, the running of approximately 3,000,000 additional train and engine miles, or an increase, as compared with the 1925–26 mileage, of 5.78 per cent. Among the increases in expenditure are £240,000 for the introduction of reduced hours of duty for engine-drivers and firemen and some other grades, £160,553 extra cost of civilised labour replacing natives, additional staff to cope with new lines, additional traffic, &c., £331,617. The Minister of Railways, in the course of his speech, announced that the Government had decided to defer the establishment of a central workshop, although it agreed with the recommendations of the Workshops Commission that such a workshop should be established at an estimated cost of nearly four millions. The considerations which weighed with the Government were the rapid growth of capital expenditure, the urgent needs of existing workshops, and—probably the weightiest of all—the question of site, which, the Minister said, was a matter requiring the greatest forethought. At the present time there are 11,974 miles of railways open for traffic and the staff consists of about 40,000 Europeans and 49,000 coloured and natives. In addition to the traffic operated by steam or electricity on the railways, the Administration is instituting road transport services wherever there is justification for introducing such facilities, and at present these services cover a total mileage of 1218.

Electric Railway Working.

A full commercial service of passenger and goods trains continues to be worked by electric traction on the Natal main line between Glencoe Junction and Mooi River, a distance of 113 miles. The partial electric service in operation between Mooi River and Balgowan was, on February 1st last, extended to Lions River, a total distance of 31 miles. The gross tonnage hauled south of Ladysmith during January totalled 505,956, a daily average, excluding Sundays, of 19,460 tons.

New Fruit Wagons.

The South African Railways Administration is calling for tenders for the construction of seventy-five extra fruit wagons. These tenders are returnable by July 1st. This order is being given out so that next season the delays and consequent wastage which took place last season shall be avoided. Besides the extra seventy-five wagons for which the tenders are called, a further seventy-five are already in the course of construction, and are to be delivered in September. These 150 wagons are to be specially designed for the general fruit trade. They will be ventilated, but will not be supplied with ice chambers. In addition to them, thirty-eight refrigerator cars, which will take in ice packing on the journey, are being built. From these cars the fruit will be transferred to the cool chambers at Cape Town to await shipment. One hundred and four wagons have recently been converted into fruit carriers.

Locomotives Ordered from Germany.

It should be noted by British workmen that the South African Railway Administration has recently ordered twenty heavy locomotives from Germany. The order was given abroad owing to the fear that British builders, faced with the probability of trouble in the coal and engineering trades, would be unable to deliver on the dates offered in their tenders, which otherwise compared favourably with most American and continental tenders.

Large Gas Plant Wanted.

The Municipality of Johannesburg, having obtained the consent of the Administrator and the Executive Committee of the Transvaal Provincial Council to its scheme for the extension of its gas plant, &c., at a cost of £300,000, is now having specifications prepared so that tenders may be invited. Mr. B. Sankey, the general manager of the municipal electricity and gas undertakings, proposes, it is understood, to call for tenders within the next two months, and four months will be granted within which to put in tenders. The policy of the Municipal Council is to invite tenders only through local firms or the local representatives of overseas firms. It will not consider tenders for a portion of the work, so that the tender must be for the whole and include erection, and the successful tenderer will have to run the plant satisfactorily for a period—six months is suggested—after which it will be taken over by the city staff. If the performance has not been satisfactory in that period, then the erecting firm will have to run it for a further period, as provided in the contract. It will be necessary therefore for firms specialising in various components of the required plant to act in conjunction, and for one firm to put in an entire tender. The municipality will put in the foundations. It is estimated that the plant equipment, &c., will absorb £220,000, and extension of distribution mains to £80,000. Should the plant, &c., cost less than estimated, the surplus will be devoted to distribution. The general manager states that the demand for gas in Johannesburg is growing so rapidly that the present plant is swamped, and he anticipates that the annual increase in demand is going to become larger and larger, as gas is becoming very extensively used, not only for industrial, cooking and heating purposes, but also for lighting. Mr. Sankey welcomes this trend as helping to reduce his present electrical peak load. For about three months in the year the demand for electricity is very great, and much of the plant which it is necessary to have to meet it is idle all the rest of the year. There are also sudden snaps of cold which may only be for a few hours in the morning, or may last a couple of days, but which often throw an extra demand equal to 2000 horse-power on the plant, and entail the putting into commission of a boiler and another set, which is costly, as there is the waste in lighting up and cooling down, and Mr. Sankey thinks that the increasing demand for gas will help him considerably here, for he points out that a sudden call upon the gasworks could easily be met by the storage in the gasometers, even if it lasted for a week.

Broken Hill Power Plant.

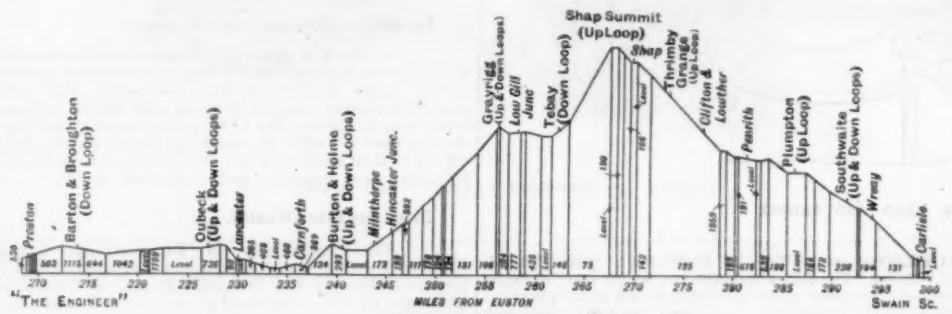
Large developments of the power plant at Broken Hill, which will make it the biggest hydro-electric power plant in Rhodesia and the Union, have been decided upon. It will be remembered that the Prince of Wales visited this great base metal undertaking, and opened the Mulungushi dam. Further extensions are now to be carried out for the generation of power for the electrolytic production of zinc. The new plant, for which orders have recently been placed, comprises two 5000-kilowatt water-wheel alternators, direct coupled to 600 revolutions per

minute Pelton wheels, each of 7200 horse-power. The plant will include outdoor-type transformers and switchgear, the transformers stepping up from the generator voltage of 2200 to 66,000 volts, at which pressure the energy will be transmitted through the bush to Broken Hill mine, a distance of approximately 35 miles. It is of interest to note that the storage dam holds up sufficient water to furnish a further 10,000 kilowatts, at least, after the present extensions are complete. The whole of the electrical plant is to be supplied by Metropolitan-Vickers, Ltd., and the Pelton wheels by the English Electric Company, Ltd. It will be about twelve months before the plant can be on the site and several months will be occupied in its installation. The Rhodesian Broken Hill Development Company, Ltd.—per the Anglo-American Corporation (S.A.), Ltd.—is calling for a large number of alternating-current motors for this undertaking.

New Loop Lines between Preston and Carlisle.

THE railway between Preston and Carlisle was opened to Lancaster in June, 1840, to Oxenholme in September, 1846, and to Carlisle in December, 1846. Because of the physical conditions which make widening very expensive, almost the whole of the 90 odd miles remain to-day as double track, just as the line was constructed, and with very little third and fourth running road. In this connection it may be related, as of historical interest, that when the Lancaster and Carlisle was sanctioned in 1844, it was as a double line. It was, however, only intended to build a single track, but when the Caledonian was authorised and a main route between England and Scotland was possible, the Lancaster and Carlisle was built as a double line.

The section in question is now one of the most important lines in the kingdom, with a valuable service of both express passenger and fast goods trains. The working conditions are made unusually difficult by the steep gradients shown in the accompanying engraving, and the comparative long distances between the block signal stations. Coupled with these factors are the varying importance of the trains passing over the section, as it is constantly necessary to shunt trains to permit more



PROFILE OF LINE BETWEEN PRESTON AND CARLISLE

important trains to pass them. The gradients and distances between signal-boxes determine the time available before a train need be shunted. Then when a shunt "inside" has to be made, the time occupied in the movement becomes another factor. Where there is a loop and a train can be turned through facing points off the main line direct into the loop, the operation is carried out much more quickly than when the whole of the train has to pass beyond the siding points in the main line and then be backed into the siding. Such facing connections and the provision of a loop instead of a refuge siding have hitherto been somewhat of a luxury, as an additional signal-box has been necessary at the facing points, seeing that they could not be coupled to the box actuating the outlet points, being beyond the distance allowed for facing points from the box whence they are worked.

The Ministry of Transport does not, however, prescribe any distance when points are worked by power, but, until recently, power operation was an expensive matter. The introduction of low-voltage electrical operation from primary batteries, accumulators or by hand-generated current has rendered the provision of a power plant quite unnecessary. As a consequence of that simplification of the situation, the London, Midland and Scottish Company has been able greatly to improve its facilities for shunting trains between Preston and Carlisle and twelve additional loop lines have been provided at the places shown on the gradient profile. Our illustration shows thirteen loops, but the down loop at Barton and Broughton is an extension of a loop already in service. Of the twelve, the down loop at Grayrigg, the down loop at Tebay, the up loop at Shap Summit, and both loops at Southwaite are cases where existing refuge sidings have been converted into running loops by the provision of facing points and an inlet into the siding near its buffer stops.

The details of the work is as follows :—

Barton and Broughton.—The entrance to the existing down loop has been carried 105 yards further south and the loop now gives a length of 445 yards in the clear.

Oubeck.—New loops on either side of the line, 1600ft. long, and a new cross-over road, operated from a new signal-box, which replaces an existing one.

Burton and Holme.—New loops on either side of the line. The existing up line becomes the up loop and the down line becomes the up main. A new down main line and a new down loop are being provided. Both loops will be longer than usual, being 1096 yards in length, and will have intermediate outlets which will divide the southern halves into a length of 541 yards and the northern halves into a length of 555 yards clear. A new box replaces the existing Burton and Holme box, which will work the intermediate outlets and the connections at the southern end. An additional box will actuate the northern points.

Grayrigg.—The down refuge siding is being converted into a running loop by facing points being inserted in the down line at the north end of the station. A new loop is being provided on the up side, which will pass behind the up platform. The removal of a considerable amount of earthwork has been necessray on the up side. A new signal-box in place of the existing one has been necessary. The points of the outlets from both loops and their corresponding trailing points on the main line are electrically operated as related below. Both loops will be 1600ft. long, clear.

Tebay.—The down refuge siding, which is on the south side of the station, will be converted into a loop 470 yards long. The replacement of an existing box is necessary.

Shap Summit.—There are two refuge sidings on the up side of the line and one will be made into a running loop which will give a length of 533 yards in the clear. The existing signal-box will have to be replaced. Electrical operation similar to that at Grayrigg is being provided for the outlet points. The provision of the new loop at Shap Summit will remove the present-day operating disadvantage that the existing siding points are on the south side of the Summit. Therefore, trains that have to be shunted must proceed for a train's length past the points, and then set back against a gradient of 1 in 75.

Thrimbley Grange.—A new up loop, 533 yards long and a new cross-over road between the main lines. The provision of a new signal-box—not an additional one—has been necessary. A brook runs near the main line near this place, and it had to be diverted on the up side.

Plumpton.—New up loop, 535 yards long, and erection of a new signal-box in place of the existing one.

Southwaite.—A refuge siding on each side of the line has been converted into a running loop, each 533 yards long, and the present signal-box replaced by a new one. The outlet points in the down loop and its trailing points are electrically operated.

In those instances where points are electrically operated a primary battery of 500 ampère-hours A.D. wet cells is provided. Each point has its own motor and detector, and each facing point has a lock in addition, which is also detected. The motors, locks, detectors, relays, &c., were supplied by the Westinghouse Brake and Saxby Signal Company, 82, York-road, N. 1, but all the work has been carried out by the railway company. The levers in the locking frame are of the usual mechanical type, and each is locked by a length of track circuit at the points which prevents the catch handle of the lever being used if any vehicle is on or near the points. That is the case whether the lever is being pulled from normal or being restored from the reversed position. If the lock is free, the lever may be moved from its then position for about two-thirds of the stroke, and that movement sends current to both motors. A check lock prevents the last stage of the stroke being completed, but when both sets of switches are fully over and the lock on the facing points has been operated, the detection causes the check lock to be withdrawn and the stroke to be completed. If the points are being "made" for a movement from the loop, the detection also takes off a lock on the signal for leaving the loop. A visual indication shows "Normal," "Wrong," or "Reversed."

Many of the distant signals are a considerable distance from their respective signal-boxes, and are therefore actuated by electrical signal motors, also supplied by the above-named firm of signal contractors.

We are indebted to Mr. E. C. Trench, the engineer-in-chief, London, Midland and Scottish Railway, for an opportunity to describe this work.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

AIR POLLUTION.

SIR,—An article by Mr. John B. C. Kershaw, F.I.C., on "Air Pollution in English Towns and Cities," has only just come to my notice, although, as you will be aware, it appeared in your issue of April 16th.

I am particularly interested in the results shown for Bournville, and, as the figures given in Group 4 of Mr. Kershaw's Table III. might readily lead one to imagine that the air pollution at Bournville during 1924–1925 was more than 60 per cent. higher than during the period 1923–1924 (4781 metric tons per 100 square kilometres), I should like to offer a little amplification of his data. It should be clearly explained that figures for the Bournville gauge were available for eight months only of the 1923–1924 period. In the corresponding eight months in the next year the pollution recorded was 4759 metric tons. Thus it will be observed that the deposit at Bournville has become slightly less instead of very much more, as the article might suggest.

Mr. Kershaw states that Group 4 in his third table contains the figures for the purely residential towns and country districts. This is not strictly true, as the statistics from Bournville were compiled from a gauge situated in the middle of a large factory. I have reason to believe that the air of the village is considerably better than is shown by these figures, which are, however, themselves extraordinarily good for the conditions indicated.

J. K. BEST,
Member of the Advisory Committee on Atmospheric Pollution.

Birmingham, May 28th.

[I am much obliged to Mr. Best for pointing out in the above letter that the Bournville figures for 1923–24 are not directly comparable with the figures for 1924–25, since they cover eight months in place of twelve. They ought therefore to have been omitted from Table III., which otherwise is quite correct. With regard to the classification of Bournville as a residential and country district, I think most citizens of Birmingham would regard it as such, and would not consider a soot and dust gauge which was erected in the centre of Messrs. Cadbury's chocolate factory at Bournville as yielding results typical of a manufacturing district.—JOHN B. C. KERSHAW, Colwyn Bay, June 1st.]

BOILER DESIGN.

SIR,—Professor Löffler claims, in his letter published in your issue of May 21st, that in his design of boiler at a pressure of 1500 lb. per square inch, the rate of heat transmission from the flue gases to the water is but little different from that of the heat transmission between the gases and the highly compressed steam. This statement is surprising, in view of the fact that the density of even saturated steam at a pressure of 1500 lb. per square inch is about fourteen times less than that of water at the corresponding saturation temperature. I would be interested to learn if your correspondent bases his statement on theoretical considerations or experimental data.

In the Löffler boiler the highly compressed steam must also be highly superheated. The mean difference in temperature between the flue gases and the superheater tubes will therefore be appreciably less than the mean temperature difference between the flue gases and the tubes of a water-tube boiler generating steam at the same pressure. As a consequence, the heat transmitted per unit of heating surface will be less in the Löffler boiler.

Your correspondent seems to have been singularly unfortunate in his experience of boilers of the "ordinary type," in which, it appears, the superheaters were burnt out at once when the flow of steam to the engine was stopped suddenly. As a matter of fact, any reputable firm of boilermakers could name hundreds of boilers in which the superheater tubes have not been renewed, although they have been in daily service for many years.

Professor Löffler states that in order to attain a high superheat temperature the superheater must be placed in the combustion space. The limit in temperature to which the steam may be superheated is determined by the properties of the materials available for construction. This limit is, at present, about 850 deg. Fah. It can be, and indeed has been, attained, and even surpassed without placing the superheater in the combustion space.

G. R. CRAMMOND.

Brussels, May 27th.

GYRATORY TRAFFIC.

SIR,—Now that one-way traffic has been tried and proved an immediate success at certain centres in London, to wit, by Buckingham Palace and in Trafalgar and Parliament-squares, it may be well to call to mind who it was that first proposed this system. It was an Englishman. At page 3 of the "Transactions" of the Civil and Mechanical Engineers' Society for the session 1907–8 will be found the following, which is from the presidential address of W. N. Twelvetrees, delivered on October 3rd, 1907 :—"Gyratory traffic regulation was first proposed by Mr. Holroyd Smith, M.I. Mech. E., M.I.E.E., who, some ten years ago, brought the idea before the London County Council, citing Ludgate-circus as a place where the system could advantageously be tried, and discussed it with various engineers and others interested in the traffic problem of Paris. Within the last eighteen months the notion has been advocated by M. Eugene Henard, a Parisian architect; by Mr. W. H. Booth, A.M. Am, Soc. C.E., of Westminster, in a letter to *The Times* : and by Mr. Schroeder, of Berlin, in a paper read before the Verein fur Eisenbahnkunde."

Hence we see the system was proposed about 1897 and was tried nearly thirty years later. Why have we waited thirty years to make a costless and simple experiment ? It took ten years before the Willett daylight saving was tried. It, too, proved an immediate success, but, unfortunately, in the meantime Mr. William Willett had died. Mr. Holroyd Smith is more lucky, for though it is about thirty years since he proposed gyratory traffic, he is still alive.

A. S. E. ACKERMANN.

London, S.W. 1, June 2nd.

ELECTRIC POWER FOR ONTARIO.

FEARS have for some time been entertained of a serious shortage of electric power for industrial purchases owing to the rapidly increasing demand. This danger has now been averted by the action of the Ontario Government, which, acting upon the recommendation of the Provincial Hydro-electric Power Commission, has authorised the completion of an agreement for the delivery to Ontario by the Gatineau Power Company, at the Ontario–Quebec boundary, in the vicinity of Ottawa, of 230,000 to 260,000 horse-power of hydro-electric energy, at a price of 15 dollars per horse-power per annum, and total delivery will be completed by 1931. The contract binding the delivery is for thirty years, dating from 1928. The Gatineau Power Company, from which the power will be received, is a subsidiary of the International Paper Company, which is at the present time constructing power plants on the Ottawa River at Chelsea and Farmer's Point, from which developments certain amounts of power will be delivered under the contract. It also proposes to erect stations at Paugan and other points on the Ottawa, including storage on the Gatineau and its tributaries. The power to be delivered will be at a maximum voltage of 230,000, and will be transmitted at a point near Ottawa to connect with the Niagara system near Toronto. The transmission lines, which will be about 230 miles in length, will cost between 10,000,000 dollars and 15,000,000 dollars. A sum of 500,000 dollars has already been voted by the province in order that preliminary work may commence immediately. The first block of power of 80,000 horse-power will furnish all the requirements of the province for the next five or six years.

Railway Matters.

THE Whitsuntide holidays were marked by a very serious collision in Munich East Station. There was some bad telescoping of the carriages and thirty-three passengers were killed.

THE retirement is announced of Mr. W. R. Bird, who for the last twenty-six years has been the chief chemist to the Great Western Railway at Swindon. He has been succeeded by Mr. T. C. Davison, who became an assistant to Mr. Bird in 1891 and his chief assistant in 1916. When the Great Western established a research department in 1922 Mr. Davison was placed in its charge.

IT is reported that the German State Railway authorities have decided to establish a new power station near Berlin to supply electricity for the Berlin Metropolitan Railway. A feature of the new plant, which is to be situated near the Berlin municipal power station at Rummelsberg, is that the boilers will be adapted to use as fuel lignite drawn from the mines near Frankfürt-am-Oder, about 62 miles away.

WORK is in hand at the works of the Sécheron Company at Geneva on the electrical equipment of four locomotives which, it is claimed, will be the most powerful in the world. The engines, which are intended for service on the Lötschberg Mountain Railway, are being provided with six 700 horse-power motors, and are intended for the haulage of trains for which two engines have hitherto been required. The locomotives have nine axles, and are 82ft. in length.

THE general manager of the London, Midland and Scottish Railway, Mr. H. G. Burgess, makes the following announcement on the conversion of the company's engines from coal to oil burning:—"Three oil-burning engines have actually been put into service on the London, Midland and Scottish, viz., Nos. 1059, 765, and 527, and a fourth has been adapted but is not yet in use. The three locomotives have been tried experimentally between Derby and Birmingham, and Derby and Manchester. If the trials at present in progress prove satisfactory, a further 100 locomotives will be converted."

WHEN the railway accident figures for 1925 are published there will appear under the heading "In Accidents to Trains, Rolling Stock and Permanent Way" the nine passengers in the road motor vehicle who were killed at Fenny Stratford on December 7th last, when their conveyance struck the level crossing gate and, fouling the railway, were hit by a train. The anomaly thus created appealed to Mr. J. H. Thomas, who asked a question of the Minister of Transport. Colonel Ashley replied that, in accordance with the Act of 1871, the accident would have to appear in the railway returns.

As a painful impression was created by the refusal of railwaymen on strike to assist in the work of rescue after the collision at St. Margaret's, Edinburgh, on May 10th, it appears desirable to say that in the debate on the adjournment for Whitsuntide the Under-Secretary for Health, Scotland, read a letter from the chairman and secretary of the strike committee in which it was said that the pickets, which included trained first-aid men, volunteered to give assistance to the injured, but it was refused. An official of the railway company stated that the breakdown gang was wanted, but the men declined. The same official later made his appeal for humanity's sake, but before this there were ambulance men, nurses and others on the scene, and it was quite evident that the men were wanted to clear the wreckage away. That they were not willing to do, but "they were not deaf, and we claim that railwaymen have never been deaf, to the call of humanity."

IN connection with the recent decision of the "Ferrovia Nord" (Italy) to electrify a portion of its suburban system between Milan and Saronno and between Bovisa and Meda, it is reported that the Brown-Boveri organisation has secured the contract for the electrical equipments against very strong competition. At present the work to be carried out consists of:—(1) The electrical equipment for the sub-station at Novate, consisting of three 2000-kilowatt power rectifier plants operating at a direct-current pressure of 3000 volts, the step-down being from three-phase, 22,000 volts at 42 periods; (2) the electrical equipment of eight four-axle motor coaches, each provided with four 184 horse-power (one-hour rating) motors, operating two in series across 3000 volts; (3) the electrical equipment of eight trailer coaches, provided with driver's cabs. A train will generally consist of a motor coach at one end, then two or three ordinary trailers according to requirements, and a trailer with a driver's cab at the other end. Control is thereby obtained at both ends without the necessity of using two motor coaches. The normal speed of the trains will be about 33.5 miles per hour and the maximum speed about 62 miles per hour.

ACCORDING to the Board of Trade export tables, the value of the railway material exported during the first three months of the present year was as follows, the corresponding figures for 1925 and 1924 being added in brackets:—Locomotives, £1,193,197 (£883,056, £583,917); rails, £586,317 (£483,715, £538,519); carriages, £556,696 (£459,416, £306,194); wagons, £984,975 (£835,310, £952,912); wheels and axles, £138,933 (£172,661, £200,610); tires and axles, £81,640 (£120,523, £183,171); chairs and metal sleepers, £268,050 (£148,759, £353,650); miscellaneous permanent way, £301,588 (£362,112, £354,605); total permanent way, £1,444,375 (£1,318,898, £1,693,737). The weight of the rails exported was 74,072 tons (50,095 tons, 60,530 tons), and of the chairs and metal sleepers 27,107 tons (11,729 tons, 27,009 tons). During the month of March last locomotives to the value of £341,555 were shipped, which included: India, £145,653; South Africa, £6409; certain countries other than the Argentine, in South America, £2356; Straits Settlements, £860; and to "other countries"—which are not in Europe or Australia—£186,277. During March also the value of the rails exported was £216,770, which included: The Argentine, £33,303; India, £26,755; South Africa, £25,596; Australia, £19,932; West Africa, £8928; Straits Settlements, £1401; New Zealand, £1072; and "other countries," £89,110.

Notes and Memoranda.

THE dam which it is proposed to construct across the Cauvery River, in India, at Metur, for irrigation purposes, will impound 90,000 million cubic feet of water, according to *Indian Engineering*. It is to be built of cyclopean masonry.

IT would seem that all our Western ideas as to the size of prime movers are hopelessly inadequate, as it is reported in the *Far Eastern Review* that there was recently exhibited in Osaka, Japan, a "gigantic Jung-Stromo turbo-generator," with a capacity of 30,004,200 kilowatts.

THE Royalite No. 4 well in the Turner Valley oilfield, of Alberta, is giving off so much gas that 10,000,000 cubic feet is burned to waste daily. It is, nevertheless, producing about 2,000,000 dollars annually in gas and oil. A scrubbing plant for extracting hydrogen sulphide from the gas has recently been erected near the well at a cost of 250,000 dollars. The gas is used largely in Calgary.

ANTIMONY was much more extensively used at one time than it is now. It was brought into great prominence by the late war on account of the large demand for it in the manufacture of ammunition, particularly bullets and shrapnel, in which it is employed as a hardening agent. Its peace uses are many, but only a few require large quantities of the metal, and although its war time production amounted to nearly 82,000 metric tons a year, it yet remained a minor metal. Its field of uses, however, exclusive of the abnormal war demand, is widening, and the consumption is increasing. Metallic antimony unalloyed has a few industrial uses. As a pigment in the form of fine powder, known as "antimony black" and "iron black," it is used for bronzing metals and plaster casts. For producing the appearance of polished steel on articles made of papier maché or pottery, it is precipitated by the action of metallic zinc on an acid solution of antimony salts. The chief use of antimony is in alloy with other metals.

AN investigation recently completed by H. S. Rawdon and Samuel Epstein, of the U.S. Bureau of Standards, and reported in the *Iron Age*, had for its purpose the study of the effect of phosphorus, one of the ever-present impurities in wrought iron, upon properties of the finished iron as made by different puddling processes. Phosphorus in wrought iron is usually regarded with some concern since it embrittles the iron or makes it cold short. Mechanical puddling appears to be more effective in reducing the phosphorus content to a lower figure than is hand puddling. Experiments were carried out on wrought iron made by each of the two methods on a "split" heat of pig iron, the two parts of the heat being refined by the two processes, hand and mechanical puddling respectively. For some purposes, such as drill pipe for which a stiff material is needed, a certain percentage of phosphorus in the iron is desirable. The amount, in such a case, is usually considerably higher than that in good quality bar iron, for which the total phosphorus ought not to exceed 0·15 per cent., or but slightly. The investigation was not extensive enough to warrant any sweeping conclusion concerning all the merits of wrought iron made by the two processes. However, nothing was noted which would show that wrought iron made by hand puddling cannot be equalled by mechanical puddling if properly carried out.

ARTIFICIAL methods of recovery, such as the use of compressed air or gas, water flooding or some method not yet in use, will doubtless have a very important bearing on the future production of crude oil and likewise on the supply of motor fuel, according to the American Bureau of Mines, Department of Commerce. Estimates differ as to the percentage of oil that is left in the sand after making use of present methods of flowing and pumping, but the figures often used are from 60 to 80 per cent. of the total amount of oil originally contained in the sand. Since the production to date has been in excess of 8000 million barrels, the amount remaining in the sands would therefore be between 12,000 million and 32,000 million barrels. The recovery of at least a part of this oil is probably the most important problem that confronts the oil industry. The introduction of compressed air and gas has been successful in limited areas, and at present there is an immense amount of activity in the district around Bartlesville and Nowata, Oklahoma. Water flooding as a means of recovering additional quantities of oil from the sand has been successfully employed in the Bradford fields in Pennsylvania for several years. Since there are now more than 300,000 producing oil wells in that country, in addition to several thousand that formerly produced oil, but have been abandoned, it can be realised that an appreciable increase in the production per well would add large quantities of oil to the daily output.

FLAT-TOP wooden culverts built flush with the road surface have, according to the *Engineering News-Record*, replaced the unsightly and more or less dangerous waterbreaks built on certain roads in the Sierras in California. The old type of waterbreaks were built by the maintenance crews late in the year, of material taken from the roadside, and essentially were mounds thrown transversely across the road. On the steep, unsurfaced mountain roads that are covered during the winter by a heavy blanket of snow the waterbreaks served a peculiar drainage requirement not met by the usual type of culvert. In the spring when the snow begins to melt, not from the top but from its contact with the ground, the water starts down the slope following depressions made by the last passing vehicle and quickly accumulates in volume and increases in velocity. Unless diverted at intervals, the flowing water will carry away the fine material of the road surface. The waterbreak intercepted this flow as well as that from the side ditch and diverted it away from the road. Last year two of the experimental flat-top culverts were built and they proved so successful that some 270 have been installed. They are ordinary wooden box culverts with tops built of three or four timbers, 4in. by 4in., and spaced 1in. apart. The top is set flush with and parallel to the slope of the road. Roadside drainage is carried through and surface drainage intercepted by the culvert. The top is removable to permit cleaning the culvert of fine material with which it may become filled during the course of summer maintenance.

Miscellanea.

As a slight recognition of the loyalty and zeal of its workmen during the recent strike, Wailes Dove Bitumastic, Ltd., of Newcastle-on-Tyne, has granted its men a day's holiday with full pay.

THE Staveley Coal and Iron Company, Ltd., near Chesterfield, has five workmen in its service at the present time with an aggregate of 316 years' service to their credit, an average of 63·20 years per man.

THE well and bore-hole which was recently the subject for a Ministry of Health inquiry, has been successfully sunk at Measham, and, after a full period of testing, has yielded a supply of some 320,000 gallons of water a day. Further powers are now being sought to complete the scheme of pumping station, reservoir and mains for the districts of Measham, Oakthorpe and Donisthorpe, all in the rural district of Ashby-de-la-Zouch.

OFFICIAL telephone figures just published show that during March last, just fifty years after the invention of the telephone, the total number of telephones in Great Britain and Northern Ireland was 1,421,150, of which 1,390,153 belonged to the Post Office system, 11,000 to railway and other private installations communicating with the national system, and about 20,000 to the systems maintained by Hull and the Channel Islands. At the present rate of development the million and a-half mark, it is anticipated, will be reached by the end of October next. The number of telephones in Great Britain has been doubled since 1913.

IT is stated in the monthly returns of the National Federation of Iron and Steel Manufacturers that the production of pig iron in April amounted to 539,100 tons, compared with 568,500 tons in March and 569,800 tons in April, 1925. There were 147 furnaces in blast at the end of the month, a net decrease of 4 since the beginning of the month. The production included 171,100 tons of hematite, 184,600 tons of basic, 142,500 tons of foundry, and 17,900 tons of forge pig iron. The production of steel ingots and castings amounted to 661,000 tons, compared with 784,100 tons in March and 597,600 tons in April, 1925; the decline in production between March and April was largely due to the Easter holidays.

A DISCOVERY, which is expected to have far-reaching effects on the aluminium industry, has, according to the *Chemical Trade Journal*, been made by Professor Pedersen, of the Technical High School at Trondhjem. Professor Pedersen's method, now stated to be past the experimental stage, consists in the reduction of bauxite to aluminium oxide by the aid of iron ore instead of coal. Crude iron of high quality is obtained as a by-product. Norsk Aluminium Co. A/S, states the *Anglo-Norwegian Trade Journal*, is interested in the new method and intends, provided the necessary concession is obtained, to harness large waterfalls at Kinsarvik, Hardanger, capable of yielding 100,000 horse-power electrical energy.

A DEBATE took place in the Dominion House of Commons on May 31st on a resolution proposed by Mr. Bristol, a member of the Conservative Party and an ex-Cabinet Minister, urging a revision of the Boundary Waters Treaty to permit of increased diversion of the water of the Niagara Falls for power purposes. Mr. Stewart, Minister of the Interior, said that a joint committee representing Canada and the United States would investigate the quantity of water that might be further diverted from Niagara without interfering with the scenic beauty of the Falls, and also the question of the permanent preservation of the scenic beauty of the Falls. The Canadian members of the committee are:—Colonel O. M. Biggar, Mr. J. G. Johnston (Chief of the Dominion Water Powers branch), and Mr. C. F. Camsell (Deputy Minister of Mines). The names of the United States members of the committee are not yet announced.

ARRANGEMENTS are being made by the Victorian Electricity Commission for dealing with the requirements of further energy by the metropolitan and outer metropolitan districts. The output of energy from the Yallourn and Newport "B" generating plants combined has now reached as high a total as 627,000 kilowatt-hours daily, and over 15,000,000 kilowatt-hours were received at the Yarraville terminal station in March. This quantity exceeded that for the corresponding period of 1925 by more than 50 per cent., and it is anticipated that the following year the output will exceed that of the current year for the same period by at least 50 per cent. Works of considerable magnitude are being carried out to accomplish a change by which energy will flow from the Commission's system to the major portion of the area served by the Melbourne Electric Supply Company. Additional electric circuits are being arranged between the Yarraville terminal station and the South Melbourne sub-station of the Commission, crossing the river Yarra by two steel towers, each 250ft. high. A number of additional high-pressure sub-stations with high-pressure connecting mains will complete these works.

A GREAT feature of the facilities of the Port of Quebec is the modern cold storage warehouse, with the fish-house and the power-house. The main warehouse has a capacity of 500,000 cubic feet, and the fish-house, which is well equipped for the freezing of fish, has a storage capacity of 1,000,000 lb. The cold storage plant is of a capacity of over 500,000 cubic feet, and the fish-house is capable of storing over one million pounds of fish. The object in building this cold storage plant was to provide for the large volume of dairy products, manufactured in the districts tributary to the Port, extending from Quebec to and including Lake St. John district, on the North shore of the St. Lawrence River, and to Gaspé on the South shore. It was also built to take care of the products of, and to develop the fisheries of the St. Lawrence River and Gulf, which are amongst the most extensive and richest fisheries in the world. The building of this cold storage warehouse will, it is anticipated, remove one of the principal obstacles which prevented steamers from making a greater use of the Port of Quebec. With facilities for perishable goods, grain, cattle, and packed freight, it will be possible for steamers to load at the Port combined cargoes which were not obtainable in the past.

THE LANGERBRUGGE ELECTRIC POWER STATION

(For description see page 570)

FIG. 9—THE TURBINE-ROOM AS WRECKED BY THE GERMANS

FIG. 10—THE TURBINE-ROOM AS WRECKED BY THE GERMANS

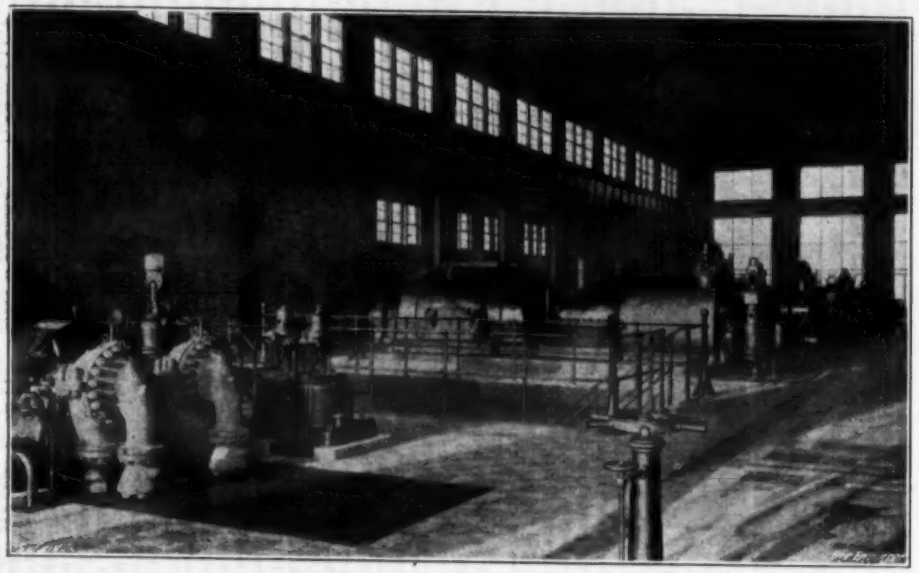


FIG. 11—INTERIOR OF RECONSTRUCTED TURBINE-ROOM

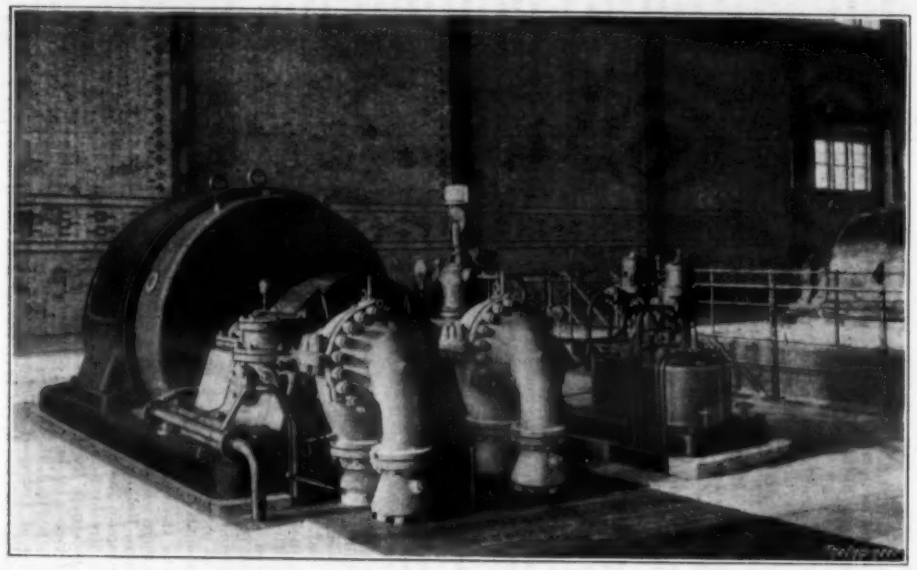


FIG. 12—ONE OF THE 2000 K.V.A. HIGH-PRESSURE STEAM TURBO-ALTERNATORS

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JUNE 4, 1926.

The Liberty of the Subject.

ONE result of the Great Strike, probably not foreseen by the T.U.C., is that several industrial problems of great importance have been revived. For many years these problems had been buried under the weight of the Trades Disputes Acts or submerged by the ever-widening stream of precedent and custom. Although well known to economists, they had almost ceased to have any actual existence, and whenever they were raised, could always be lightly dismissed on the ground that they were settled years ago, or that it was, now, too late to do anything. But when union after union, acting under the instructions of the Trades Union Council, obliged its members to break contracts of employment, trades unionism placed itself in an entirely new position, and dissolved at once those barricades against change which had grown stronger and stronger as the years passed by. Even the notorious charter of trades unionism, the Trades Disputes Act of 1906, became at once more vulnerable, and it was openly said by influential speakers that that Act would have to be modified or repealed. Successive attempts have been made to overthrow it, but it has taken such a firm hold that its overthrow seemed impossible till the action of the T.U.C. gave an opening. The Government itself, it will be recalled, took steps through a Proclamation to remind the trades unions that picketing could only be carried on legally within strict limitations, and that any excess—an excess which the unions had practised with impunity under the ambiguous terms of the Trades Disputes Act—would be promptly and severely dealt with. Picketing, as we all know, has been pushed to the extreme limit of the law, not alone by actual intimidation at the gates of factories, but, worse still, by moral intimidation in the homes of workpeople. Whether or not such practices were foreseen by the promoters of the Act we cannot say, but they are certainly not within the intention of the Act, and it will indeed be surprising if means are not taken by Parliament to restrict them, and to afford to all workpeople those rights of liberty which they may justly claim under the Constitution of the kingdom.

Picketing is one form of coercion. It is clear to all; but there are other forms which are less obvious, but not less effective, and we believe we are justified in asserting that a large majority of the working people of this country resent them, and could be trusted, were they in a position to do so, to oppose them with energy and effect. The closed shop and the open ballot are notorious examples. With the gradually increasing "recognition" of trades unions, shops came to be more and more firmly closed against all who were not members of some union, until, as everyone knows, we reached the perfectly intolerable position in which a whole factory, even a whole industry, might be thrown into idleness because a single non-unionist was employed. Managements were almost powerless in the face of such tactics, and though they professed to keep open shops, although they made no inquiries concerning the connection of their employees with unions, they well knew in a great many cases that their works were not really "open," and they had to wink at the coercion exercised by the unions upon their "free" workmen. Already, since the strike, steps have been taken in many places to overthrow this particular form of coercion, and it is sincerely to be hoped that open shops will increase in number, and that the power of unions to upset industry because they object to the employment of non-union hands will be destroyed. Any strike called openly or indirectly with that purpose in view should be made just as illegal as the lightning strike, and with illegality all the amenities enjoyed by trades unions should automatically lapse. The liberty of the subject must be preserved. Another practice which permits that liberty to be continuously outraged is the open ballot. That that practice, which is opposed to all the principles of equitable voting and would justly be regarded as infamous in any other circumstances, has been allowed to prevail within trade unionism is a matter for sheer astonishment. It is absolutely without defence; it is recognised by the unions themselves as a powerful weapon in the hands of a minority; it has led to courses which are opposed to the wishes of the majority, and has enabled unions to employ their funds upon objects which have not the sympathy of the bulk of their members. It has been the direct cause of more industrial strife—by placing power in the hands of autocratic minorities—than anything else, and yet it has been tolerated by the unwilling members themselves, and has been suffered by Governments to prevail. So long as the activities of unions were prosecuted within reasonable limits, there were perchance no grounds for interference with their internal affairs, but since they have greatly extended the ambit of their exertions, and especially since they have shown that they would, if they could, hold the whole country at ransom, the time has come when the same principles which are enforced in elections should be enforced in trades union ballots. Nothing but the secret ballot can ensure to the individual subject that right, which no one can deny him, to record that vote to which he is inclined free from the coercion or censure of those who disagree with him.

It will be said that the adoption of the reforms to which we have referred—the strict limitation of picketing, the open shop, and the secret ballot—are inimical to the interests of the trades unions. We do not know, and we do not greatly care one way or the other. We are no enemies of trades unions, we believe they have done a great deal of good, and, properly conducted, will continue to serve a valuable purpose. It is not to trades unionism that we object, but to the autocracy of those who sway them for their own purposes. The liberty of the individual, under the laws of the land, is the prime consideration. The trades unions notoriously interfere, by the three means with which we have dealt, with that freedom. They will again do so if a limit is not put to their exertions. In the interests, we sincerely believe, of trade unionists themselves, of all the workpeople of the land, and of the nation as a whole, reform is called for. Coercion, whether it is effected through picketing, through the open ballot, or through strikes against the open shop, can no longer be tolerated. It has done too much harm already; the extent of its ambition has been revealed by recent events, and the time has come when, once and for all, an end must be put to it.

British Steel.

IT is rarely that we are called upon to consider such a foreboding address as that which Sir Peter Rylands delivered from the presidential chair of the Iron and Steel Institute yesterday. It is difficult to find in it a single ray of light, and it is wanting even in that buoyancy with which, in the worst of times, we look upon a gloomy future. This is bad, but the worst of it is that, at first glance, Sir Peter seems to have justification for his despondency. Look, for example, at the diagram which we reproduce on page 575. Until the nineties the United Kingdom ran neck-and-neck in steel production with continental Europe and the United States. Then

those countries began to outstrip it. That was only natural, for they were beginning at last to develop their national resources. Their output expanded at a great and almost equal pace up to the beginning of the Great War. During this period Great Britain did adequately, if not brilliantly. The curve of output moves steadily upward, almost to the end of the war. Then came the depression of 1919–20, followed by the meretricious boom, and in America and Great Britain, by the great slump. The two curves then turn upwards again till the end of 1923 is reached. So far the diagram gives no cause for serious anxiety. The movements in Great Britain had their counterparts in continental Europe and in the United States; there was nothing that would lead us to fear that a revival would not come in the course of time. But at the end of 1923 our curve of output ceased suddenly to rise, whilst that of Europe bounded up. The output of the United States also fell, but at the beginning of 1925 rose again quickly, whilst that of Great Britain continued on the downward gradient.

We have outlined the course of events with a particular purpose in view. It will be seen from our figures, and particularly from a careful inspection of Sir Peter Rylands' illuminating diagram, that even up to the beginning of last year there was little to cause grave anxiety. The conditions on the Continent were exceptional, whilst our curve corresponded fairly closely with that of America. Our output should have taken an upward turn some sixteen months ago; it did not do so. A recession began when there should have been an accession. Hence it may be said that our despondency rests almost, if not quite, on the events of a little more than a single year. Is that period sufficiently long to give grounds for serious misgivings? It is obviously impossible to answer that question. Sir Peter Rylands himself points, very properly, to the astounding fluctuations which began with the war. The indicator needles, which had followed a reasonably steady line for over forty years, suddenly flicked about as if disturbed by an earthquake. Have they yet resumed their steady movement? Have we any right to extrapolate on such erratic behaviour and say either that the upward tendency has been resumed in the United States and on the Continent of Europe, or that a downward tendency has definitely begun in Great Britain? We should hesitate to do so. The present depression in this country may be no more than a passing phase; all our industries have lagged behind those of America and the Continent since the war. For one cause and another we are recovering slowly, and it may well be that the final depression of the curve is no more than one, possibly the last, of a series of damped oscillations. It would be unsafe to say, even, that the upward tendency in America will continue without a check, and it should not escape notice that the continental curve for last year is materially less steep than that for 1924. We do not say these things to encourage false hopes; we say them simply because if these steel output curves are analysed as scientific curves are analysed they provide us with no facts that warrant despondency. We are not to be discouraged by a year of bad trade. Indeed, the very fact that nearly the whole trade of the country has been bad should be a source of some comfort to the steel industry. Its depression is not the result of its own failings but, in very large part, no more than the reflection of the general state of industry. Consider, alone, the difference that the curve would have shown had shipbuilding recovered, and the increase of consumption that would have resulted from an improvement in the general engineering industries. It may be said that had the steel industry been better, then engineering and shipbuilding would have followed it. But we do not know that that is the right order in which to put the issues; we do not know which is the cart and which the horse. But we do know that the steel industry cannot be considered in isolation from other industries, and we suggest that, in view of the general condition, there is, so far, no occasion for deep despondency about the future of steel.

But whilst we refuse to share Sir Peter Rylands' depression, it must not be supposed that we see no need for the reorganisation to which he alludes. That reorganisation must grow up within the industry itself, and the form it takes must be decided upon by the experience of steel masters themselves. Hitherto the steel trade of this country has flourished, as Sir Peter indicates, upon the quality of its products. Can it continue to do so? "No doubt," said the President, "the pursuit of special qualities is not entirely compatible with the policy of large and standardised production, and as long as the capacity of Great Britain can be satisfied by special business of this kind, and the manufacturers concerned are content, a valuable and important industry can be maintained; but if, as appears now to be essential, Great Britain is to secure a greater share of the world's steel trade, it may be suggested that a different policy is imperatively demanded." We are brought, it will be seen, once more to mass production and the American example. We cannot get away from it. The astounding prosperity of America has set us all by the ears. We can think of no plan but to follow its example, and aim rather at quantity than quality. Yet let us beware. We may sacrifice our birthright. Our foreign trade has grown up and lives upon the reputation for excellence. Even America buys British goods when it wants the best. If we throw away this advantage is it certain that we can replace it by something better? The conditions which have produced the American system do not exist here. No American even has succeeded completely in transplanting his native methods in British soil. It is, at least, very questionable that we can ever compete with the United States in the "hurry-scurry" system. But where quality is the first consideration we can hold our own, and do adequate business. It is probably rather by careful reorganisation of our own methods than by the adoption of alien methods that our steel industry has most to gain.

Water-power for the Paris-Orleans Railway Electrification.

The partial electrification of the lines of the Orleans Railway Company is the subject of an article by M. Parodi in the *Revue Générale des Chemins de Fer*, and it contains information regarding the sources of water power which are to be utilised for that purpose. The extent of the water resources available and the expected electrical energy output is shown in the subjoined table. Eguzon, it may be explained,

Utilisation of the River Creuse and River Dordogne.

Power station	Eguzon.	Coindre.	La Cellette.	Vernéjeux (Maréges)
Head, in metres	58	120	42–80	60
Area of catchment, sq. kilos.	2,400	540	464	2,400
Flow, mecusecs	35·2	14·5	12·2	63·2
Millions of kilowatt-hours	120	104	48	227
Power in kilowatts	50,000	25,000	25,000	60,000

is situated on the river Creuse; Coindre on the Rhue, and La Cellette on the Chavanon, both tributaries of the Dordogne, on which Vernéjeux is situated.

It is proposed to provide for the first part of the electrification by two groups of power stations—(*a*) thermic stations at Gennevilliers, Vitry and other places, and a hydro-electric station at Eguzon (these for the electrification of the Paris–Châteauroux section); and (*b*) the three other hydro-electric stations in the table, for the electrification of the remainder of the lines. The works for three of these power stations have been begun, and it is expected that power will be available from Eguzon and Coindre this year or next. It is intended that the Eguzon station shall operate in parallel with the thermic stations of the Paris region, and it is taken into reckoning as though it were a source of the supply of 40,000 kilowatts from Gennevilliers. This arrangement makes it possible fully to exploit the variable flow of the Creuse. The mean flow of this river in a normal year is 35·2 mecusecs; in a dry year 25·35; and in a very dry year 10·09. There does not seem to be any possibility of creating storage to reduce, substantially, these differences, but the variations in monthly flows are such that it was not desirable to throw upon the thermic station the whole burden of maintaining a regular output. In a mean year the following are the flows by months, in litres per second per square kilometre:—January, 24·80; February, 19·05; March, 23·55; April, 21·30; May, 17·00; June, 10·20; July, 7·15; August, 4·20; September, 4·55; October, 6·40; November, 15·8; December, 22·45. There are thus seven consecutive months in which the average flow is above the mean for the year, 14·68, and five months in which it is less than the mean. The average flow of the month of greatest flow is 1·69 of the mean; of the month of the least flow, 0·29 of the mean; and the greatest, 5·9 times the least.

The power available in a year such as the average of 1912–1921 is estimated as 13,600 kilowatts; in a dry year, such as 1918, 9760; and in a very dry year, such as 1921, 3880 kilowatts; the respective totals of energy being 120, 85·5 and 44·1 million kilowatt-hours.

The Dam on the Creuse.

To provide for regulation of the flow a reservoir of 50 million cubic metres capacity will be created by building a dam, 60 m. in height, giving a head of 58·4 m. from full reservoir level, 50·7 m. from lowest draw-off level, and an average of 56·00 m. The available storage of 30 million cubic metres represents 2·14 million kilowatt-hours. The length of the dam along the crest is to be 355 m. and along the base 80 m., thickness at base about 52 m. The section shows a form nearly triangular, and a height of 61·11 m. above the lowest part of the foundations, which are about 4 m. deep in the rock—gneiss and amphibolite. The width at base is 52·72 m., the upstream batter 0·06, and the downstream batter 0·834. Both faces are formed of rubble or a similar type of masonry in cement mortar, the upstream face being rendered to a thickness of 4 cm. The mass of the dam is of cyclopean concrete. About 10 m. above the foundation there are two longitudinal drainage tunnels, one at about one-fifth of the width from each face, and the masonry is drained into the upstream tunnel, from above and from below, by rows of small vertical drain holes, 30 cm. in diameter. To provide for a rise of temperature due to the setting of the cement, the length of the dam is divided into separate sections by expansion joints, and in each joint a gap of about 1 m. square section is left near the upstream face, forming a vertical shaft, and these will be filled up after a year or more from the completion of the dam. A little downstream of the gap there is in each joint a small drain hole.

Overflow.—On the right bank there is an automatic sluice, 7·5 m. in width, and a weir with eight 3 m. openings. The water from these is received in an inclined shaft, 5 m. in diameter and 46 m. long, which leads to a tunnel, 80 m. long, the outlet of which is 35 m. downstream of the power station. On the left bank there are four sluices of 7·5 m. opening, and a flank weir, 25 m. long, formed in the river wall of a canal leading to the sluices. Three of these sluices are of the Stoney type, with hand and electric gear, and the fourth is automatic. Their joint discharge capacity is 970 mecusecs, and that of the weir is 115 mecusecs, presumably at full reservoir level, and 214 mecusecs presumably at highest flood discharging level. The total discharge of 1385 mecusecs exceeds by more than 50 per cent. the estimated maximum flood of 900 mecusecs. There are two draw-offs, one near each end of the dam, and the rate of draw-off may be as high as 100 mecusecs.

Power Station.—The power station is situated at the foot of the dam. There are to be six vertical axis Francis turbines, each of 15,000 horse-power, head 55 m., flow 25 mecusecs, 250 revolutions per minute. The guaranteed efficiencies for heads between 50 m. and 40 m. range from 80 to 84 per cent. at full load, 85 to 80·5 per cent. at three-quarter load, and 79 to 74 per cent. at half load. The three-phase generators, each rated at 12,500 kilovolt-ampères, voltage 10,500, 250 revolutions per minute, will have guaranteed efficiencies ranging from 94 to 96·5. Two Pelton wheel sets will also be installed as a reserve, and to supply current for excitation and auxiliary purposes.

The Power Station of Coindre.

The power station of Coindre is situated on the Grande Rhue, a little upstream of its confluence with the Petite Rhue. There will be a dam and reservoir on each of these streams, the catchments being respectively 360 and 180 square kilometres in area. The joint capacity of these reservoirs will be about 2,000,000 cubic metres, corresponding to 460,000 kilowatt-hours. The head, presumably the same in both cases, will average 120 m., being 125 m. with reservoirs full and 115 m. from draw-off levels. The power is estimated for an overall efficiency of 70 per cent.; for an average year based on the records of 1912–1921, 11,900 kilowatts; for a dry year, such as 1918, 7800 kilowatts; and for a very dry year, such as 1921, 4510 kilowatts; these corresponding respectively to 98·7, 66·9 and 42·6 million kilowatt-hours.

The diagram of stream flow—the means for months during 1912–1921—is the sum for both streams and closely resembles that of the Creuse, the flow being above the average for seven consecutive months and below the average for five consecutive months. The mean flows for the months are, in litres per second per square kilometre:—January, 37·72; February, 32·55; March, 42·61; April, 39·96; May, 27·19; June, 16·04; July, 14·36; August, 10·65; September, 10·86; October, 16·70; November, 30·86; December, 36·58; mean for the year, 26·34. The average flow of the month of greatest flow is 1·62 of the mean, and that of the month of least flow 0·40 of of the mean; and the greatest is 4·05 times the least.

The flows during the period 1912–1921 are presented as averages for each year, in litres per second per square kilometre, and were, for those ten years:—25·64, 28·10, 25·03, 34·87, 37·10, 28·45, 19·92, 33·72, 20·80, and 11·18 litres per second per square kilometre. Thus there were three years of almost the mean for the period, 26·34, followed by two years in which the flows were, respectively, the next greatest and the greatest annual flows of the period, that of the next year being a little above the mean. The following year was that of least flow but one, followed by that of third greatest flow. In the last year but one the flow was about four-fifths of the mean and that of the last year was less than half the mean. The best series of three years averaged 1·32 of the

mean. There were not three successive years below the mean, but two which preceded a year of nearly the mean flow averaged only 0·605 of the mean. As relating to calculations of the economic capacity of a reservoir, the following may be noted :—Average flow of maximum year to mean flow, 1·41 ; average of two successive years of good flow, which were in fact the greatest and the next greatest, 1·36 times the mean ; flow of worst year, 0·421 of the mean ; average of worst two successive years, 0·607 of the mean.

THE TWO DAMS : COINDRE.

Grand Rhue.—The middle portion of the dam on the Grande Rhue is to be curved in plan to a radius of 137 m., and this portion is designed as an arch dam, the flank portions being straight. The section shows the foundations trenched into rock to depth indicated by alt. 644 m., the rock upstream being at alt. 645. Downstream it is 647 m. in the floor of a gulley, the level being 652 m. at each side of this gulley. The base of the foundation is 16·36 m. wide, very small batters, 0·02 m., reducing this to 15·30 m. at alt. 670·50. From this level the upstream face has a batter of 0·05 to the crest, the downstream face batter of 0·02 being continued a few metres higher where it is joined by a curve to a batter of 0·695. The continuation of this line through the crest portion meets the other face at water level, alt. 692·50. The solid crest is at alt. 693·00, and the section is thus nearly a triangle on a rectangle, the upper gravity part corresponding to the straight flank portions of the dam. The crest is just wide enough for a roadway of 2·20 m. between the parapets. The lengths are :—Curved part, 21·24 m.; right flank, 28·20 m.; left flank, 25·00 m.; total, 74·44 m. Vertical drains are provided in the masonry of the dam, comprising accessible drains, 0·75 m. in diameter and 7·0 m. apart, and between these two drains of 0·25 m., in each case. These drains lead to two inspection tunnels, an upper one at alt. 670·50 and a lower one at alt. 650, which collect the water and discharge it by a tunnel which opens on the downstream face. The dam is built of cyclopean concrete, 75 per cent. cement concrete with 25 per cent. of plums. The depth of water at the dam is shown as 45 m., with 0·50 m. of freeboard.

Petite Rhue.—The dam on the Petite Rhue is similar but of less height. It is curved in plan to a radius of 49 m. The section shows the bottom of the foundation at alt. 663·50, in rock, the surface of which is at about alt. 667. The width at the bottom of the foundation is 14·50 m. The upstream toe is vertical below the rock surface. Above it, the upstream face has a batter of 0·05 to alt. 693, and above that level a slightly greater batter to the crest, at 696. From the bottom of the foundation the downstream face has a batter of 0·02 to about alt. 673, where a curve joins it to a batter of 0·650, the line of which is continued to alt. 695 at the upstream face. This slope is joined to the downstream face of the crest portion by a curve of 5·0 m. radius. Two inspection tunnels are shown, a freeboard of 2 m. is indicated, and a water depth of 26 m.

Surplusing Works.—The reservoir on the Grande Rhue is provided with two sluices, each of 16 m. width, discharging from the normal water level 360 mecusecs, and from maximum water level 460 mecusecs. They are provided with automatic valves, intended to maintain a constant water level. The reservoir on the Petite Rhue will have a surface weir, 35 m. in length on the left bank, at right angles to the dam, discharging 270 mecusecs from the maximum water level.

Leat Tunnels and Pressure Pipes.—There are two tunnels one from each dam, uniting at a point about 1 kilom. from the power station to form a single tunnel which passes through the balancing chambers, described in this case as a "chimney" or shaft, 34 m. in height. It is excavated in rock and lined with reinforced concrete. The capacity of its lower portion is 360 cubic metres and of its upper portion 1460 cubic metres. The three pressure pipes, all of 1·55 m. diameter, are 150 m. long, the vertical measure of descent being 100 m. The shell thickness at the lower ends is calculated for a static pressure of 13 kilos. per square centimetre, and a dynamic head of 18 kilos. per square centimetre.

Generating Plant.—Each pressure pipe will serve a set, including a vertical axis Francis type turbine, head 117 m. to 124·5 m., 428 revolutions per minute, the horse-power ranging accordingly from 10,520 to 11,500. The table of efficiencies shows a range of 80 to 81 per cent. at full load, 85·5 to 86 at three-quarter load, and 81·7 to 81·5 at half load. The direct-coupled generators are of the self-ventilating type, 9500 kilovolt-ampères, 428 revolutions per minute, 5500 volts, 50 periods. The table of efficiencies shows a range from 93·4 to 96·1.

The transformers, which are arranged 110 m. from the power house, are of the "outdoor" type, three groups of three-phase transformers each of 9300 kilovolt-ampères capacity, and each comprising three monophase transformers of 3100 kilovolt-ampères. The voltage is to be raised from 5500 to 90,000 for transmission.

IT is said that the Turkish Petroleum Company proposes to expend about a million sterling on drilling test wells in Iraq.

Literature.

The Engineer and the Prevention of Malaria. By HENRY HOME, M. Inst. C.E. London : Chapman and Hall. 13s. 6d. net. 1926.

IT is a somewhat curious coincidence that two books dealing with a rather unusual subject—the prevention of malaria—should have come before us at such a short interval apart. In our issue of February 5th last we printed a review of a book, entitled "Bats, Mosquitoes and Dollars." It was by an enthusiastic American medical man, a Dr. Campbell, who lives at San Antonio, Texas, and who claims, first, to be able to build roosts that bats will take to and inhabit in vast numbers, and, secondly, that where such bat roosts have been erected malaria has ceased to exist. Now, there comes a book written by an Englishman and from an entirely different point of view, though it has for its object—as had the other—the elimination of the various types of malaria-carrying mosquito. The American—a doctor—is for doing everything possible to foster and encourage the bat, the parasites on which he declares to be entirely inoffensive to mankind. On the other hand, the Englishman—an engineer who has had experience of the problem of combating malaria on the Central American coast, in the West Indies, on the West Coast of Africa, in Egypt, in Syria, &c.—remarks : "Bats are said to be useful, and bat roosts have been established in at least two towns in the United States with a view to the breeding of enough bats to greatly reduce the mosquito pest. A great number of bats would be required for effective work, and the introduction of these verminous and insanitary beasts is to be deprecated, if only for the sake of the nerves of the ladies." The two authors therefore approach the problem from entirely different directions.

Let us see how the engineer would gain the desired object. He, taking the United States Public Health tract "Malaria" as his model, divides the measures to be taken to prevent malaria into four headings, as follows :—I., Malarial Survey : Destruction of *Anopheles ;* II., Preventing Access of Mosquitoes to Fit Men ; III., Preventing the Infection of Mosquitoes ; and IV., Giving Immunity Against Malarial Fever. Taking these four in reverse order, to give immunity against malaria, quinine is of course recommended. To prevent the infection of mosquitoes it is proposed to treat infected men until they are completely cured, and to keep them during the process under screened conditions, while to prevent access of mosquitoes to fit men, screening is advocated. Saving for the fact that, as far as we are aware, there is no real cure for malaria, no one will disagree with the author on these points. It is the first heading—the destruction of *Anopheles*—that he discusses at the greatest length. He divides it into three subheads :—(*a*) Biological Means ; (*b*) Destruction of Breeding Places ; and (*c*) Destruction of Shelters : Cutting Down Bush and Weeds.

Now, there are about 1000 different kinds of mosquito known. Not all of them bite mankind, and of those that do bite, by no means all are malaria carriers. It is the work of the biologist and of the entomologist to find out, first of all, the species that is responsible in a given district for the incidence of malaria, and, secondly, to ascertain its life history, the water it lives in, whether clear hill streams, jungle pools, muddy water, or brackish water in sea marshes ; its food ; the chemistry of the water ; its preference for sun or shade ; its limitations in altitude, hibernation, &c. It is only when all these factors are accurately known that the engineer can set to work with any real hope of complete success. Even when, however, he is in possession of all this information, the matter is by no means all plain sailing, for one or other of the harmful species of mosquito may flourish under such differing conditions as those appertaining to such varying altitudes as sea level and, say, 13,000ft. It is by no means certain that methods which are successful in the lowlands will prove equally efficacious when mountainous districts have to be dealt with. The engineer is further faced with the unfortunate fact that if he does certain things he may destroy the species with which he is particularly at war, but, at the same time, he may be rendering the land he has treated attractive to another, and possibly just as dangerous, a species. Then, again, a given swamp or stretch of water may not be always either suitable for or inimical to the breeding of the mosquito larvæ. For example, it is known that the larvæ do not flourish throughout the year in rice fields.

Hence, there are many aspects of the question to be studied, and that is what the author has set himself to do. He discusses lowland drainage in many aspects ; the effects of forest and jungle ; saline marshes, lagoons and mangrove swamps ; mud flats ; vegetation ; clearing silt from river channels ; seepage from irrigation systems ; and a host of similar subjects.

Then he turns his attention to hill drainage. In hilly country the difficulties met with are not always the same as are experienced in the plains. For example, the larvæ of certain *Anopheles*, particularly *A. maculatus*, *A. karwari*, *A. aitkeni*, are able to maintain their position in swift-running streams by means of dorsal tail brushes which terminate in little grappling hooks. *A. maculatus*, which is described as having caused much economic loss in British Malaya and Java, "breeds in clear streams and crystal brooks, and cannot be eradicated by weeding the edges of the streams. In spite of a strong current, it can hang on to rocks and pebbles in a stream where not a blade of grass or other aquatic vegetation is to be found ; although it is no less at home when a stream is full of grass, provided there is sufficient flow to keep the water fresh." As can well be imagined, the problem of getting rid of such larvæ is very different from that propounded by larvæ whose natural habitat is stagnant water. The means suggested for destroying *A. maculatus* are :—(*a*) By trench or subsoil drainage ; (*b*) by altering the composition of the water in such a way as to make it uninhabitable to the larvæ ; and (*c*) by flushing the streams. In the last-mentioned alternative the beds of the streams must not, of course, be erodible. Swamps are, of course, also met with in the hills, but they can nearly always be treated in the same way as lowland swamps.

After a chapter devoted to the description of details of various drainage works, the author next turns to the subject of oiling, starting by giving an extensive abstract from an article on "The Theory of the Use of Oil for destroying Mosquito Larvæ," by Harvard Whipple, which was published in the *American Journal of Public Health*, 1925, and which sets out the principles governing the use of oil and its practical application very clearly. The comparative effects of various oils, and the disadvantages attached to the use of oil are then reviewed, and a short space is devoted to larvæ-eating fish, and other natural enemies of the mosquito, such as dragon flies, birds, &c. It is here that reference is made to the bat, as mentioned above.

The first portion of the book contains a great deal of information about mosquitoes as a whole, and at the end there are appendices treating of (1) Mosquito Netting, by Brevet Lieut.-Colonel W. P. MacArthur, D.S.O., M.D., &c.; (2) Applied Entomology, by P. A. Buxton, M.R.C.S., L.R.C.P.; (3) House Flies ; and (4) Water.

SHORT NOTICES.

Surveying for Settlers. By W. Crossley. London : Crosby Lockwood. 1926. 5s. net.—This is a most interesting little book, and tempts the town liver to wish that he might, like the author, go into more or less undeveloped lands and make shift with the natural resources of the country. For Mr. Crossley does not confine himself to surveying, but gives a lot of hints on pioneering work, such as the making of roads, the utilisation of water power, and so forth. That part of the book devoted to surveying does not pretend to give detailed instruction for carrying out a highly accurate survey, but rather for the general purposes of occupying new land, which may subsequently be properly surveyed.

Loud Speakers : Their Construction, Performance, and Maintenance. By C. M. R. Balbi. London : Sir Isaac Pitman and Sons, Ltd. 1926. Price 3s. 6d.—In this little volume we find brief descriptions of nearly all the loud speakers which are now on the market. Although there is an outline of the science of the problems of sound transmission involved in the designs of loud speakers, the book cannot be described as a scientific text-book. It is obviously intended rather for the ordinary user of "wireless" than for the serious investigator. A table at the end, which gives the principal characteristics of loud speakers on the market, is useful. They all appear to be good, whilst some are excellent.

BOOKS RECEIVED.

Cargo Handling at Ports. Second edition. By Bryson Cunningham. London : Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 13s. 6d. net.

Gas and Fuel Analysis for Engineers. Tenth edition. By A. H. Gill. London : Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 8s. 6d. net.

The Engineering Index, 1925. New York : The American Society of Mechanical Engineers, 29, West Thirty-ninth-street, New York, U.S.A. Price 12·50 dollars.

Report of the Bridge Sub-committee on Track Stresses, 1925. Technical Paper No. 245. London : Office of the High Commissioner for India, 42, Grosvenor-gardens, S.W. 1. Price 4s. 9d. net.

The Principles and Practice of Surveying. Vol. II., Higher Surveying. Third edition. By C. B. Breed and G. L. Hosmer. London : Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 17s. 6d. net.

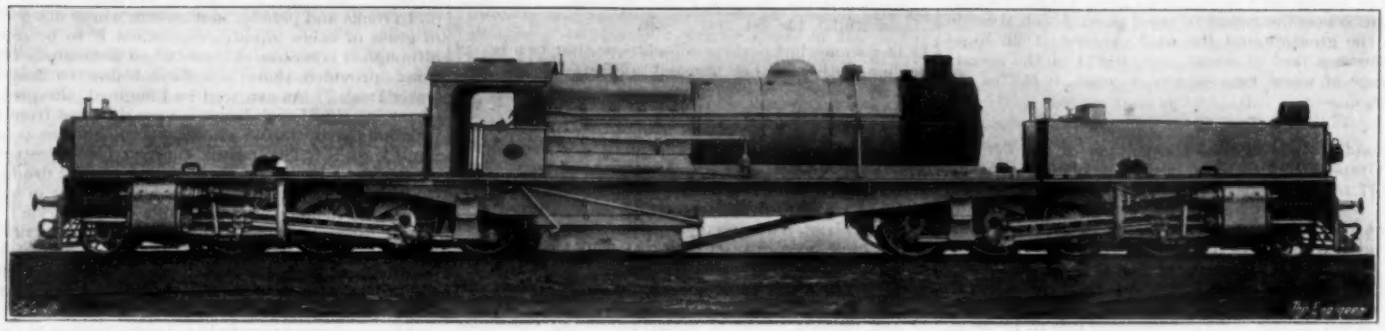
Annales des Ponts et Chaussées :—Partie Technique, 96e Année. Tome I., Fasc. I., 1926—*I., Janvier-Février, and Partie Administrative, 96e Année, Fasc. I.*, 1926—*I., Janvier-Fevrier.* Paris : A. Dumas, 6, Rue de la Chaussée-d'Antin.

Report on the Economic Situation in Belgium, together with an Annex on the Economic Situation in the Grand Duchy of Luxemburg. Revised to February, 1926. By J. Picton Bagge, Commercial Secretary to H.M. Embassy, Brussels. (Department of Overseas Trade, Official Report.) London : H.M. Stationery Office, Adastral House, Kingsway, W.C. 2. 1926. Price 4s. net.

THE New York State Water Power Commission has granted a preliminary permit to the Lower Niagara River Power and Water Supply Corporation for investigation of a possible power project in the Niagara gorge.

BENGAL-NAGPUR RAILWAY—"GARRATT" LOCOMOTIVE

BEYER, PEACOCK AND CO., LTD., MANCHESTER, ENGINEERS



Bengal-Nagpur Railway: "Garratt" Locomotives.

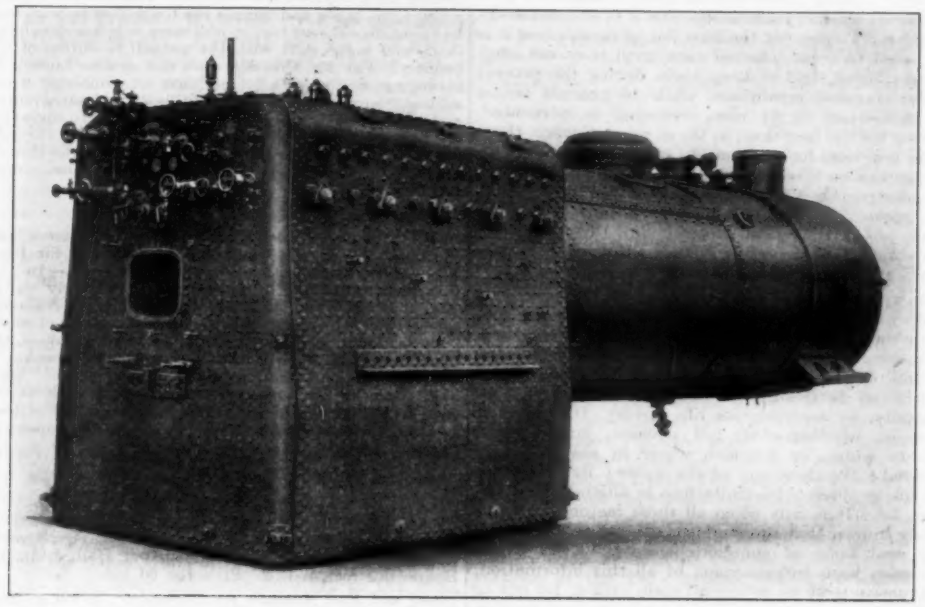
EARLY in the year Beyer, Peacock and Co., Ltd., of Gorton Foundry, Manchester, delivered two "Garratt" articulated locomotives to the Bengal-Nagpur Railway. These engines are more powerful than any other in service in India, as they have a tractive effort of 53,500 lb. at 85 per cent. boiler pressure. They have been designed for hauling 1500-ton goods trains over the section of the main line from Chakardarpur to Jharsujuda, on which there are long gradients of 1 in 100 and 1 in 150.

In general design, as may be judged from the photograph reproduced above, the engines are on simple lines, having two cylinders only on each engine unit. The cylinders have piston valves actuated by Walschaerts gear. This gear, together with connecting-rods, coupling rods, coupled wheels and axle-boxes—the latter being of cast steel with gun-metal bearings—are duplicate with those of the standard 2-8-0 type engines of the railway company, the coupled wheel base being, of course, identical. As far as possible the boiler mountings and other details are of the Bottomley radial arm type, which has the two-axle-boxes in one casting.

The general particulars of the engines are as follows:—

Cylinders	20in. by 26in.
Coupled wheels	4ft. 8in. diam.
Truck wheels	3ft. diam.
Wheel base of each engine unit	24ft. 2in.
Rigid wheel base	16ft.
Total wheel base	76ft. 6in.
Boiler pressure	180 lb.
Heating surface—	
Tubes	2954 sq. ft.
Fire-box	263 sq. ft.
	3217 sq. ft.
Superheater	642 sq. ft.
Total	3859 sq. ft.
Grate area	67·3 sq. ft.
Tractive effort at 85 per cent. B.P.	53,500 lb.
Water capacity	5500 gallons
Fuel capacity	8 tons

In addition to the special fittings already mentioned, the engines have Pyle National electric headlights, Lambert sanding gear, and C. C. Wakefield's "Eureka" type displacement lubricators.



BOILER OF "GARRATT" LOCOMOTIVE

of the engines follow the standard of the Bengal-Nagpur Railway Company, so that interchangeability has been taken advantage of to the fullest possible extent.

The boiler, which we illustrate, is of the Belpaire type with copper inside fire-box fitted with nicro-copper stays in the breaking zones. The Superheater Company's "Stirling" superheater is fitted. It has forty-eight elements with 1⅝in. outside diameter tubes. The inside diameter of the barrel at the front end is no less than 7ft.; its length is 13ft. 3in. The fire-box is 10ft. outside and 9ft. 1⅛in. by 7ft. 4⅛in. inside; its height from the foundation ring is 7ft. 5in. From these dimensions the great volume of the fire-box can be appreciated. The grate is fitted with rocking finger bars, in two sections, which can be operated by a steam cylinder, or each section can be moved separately by hand lever. The ashpan is of the usual type fitted to "Garratt" engines, having side cleaning doors in addition to the front and hind air doors.

The boiler is fed by two Gresham and Craven non-lifting injectors which deliver through clack boxes into a stand on the top of the front barrel ring. Four Ross pop safety valves are fitted and anti-vacuum or relief valves are placed on the top of the superheater header. The fire-box is fitted with a Parry tube cleaner.

Brake blocks operated by a steam cylinder act on all the coupled wheels, and the automatic vacuum brake is also applied to them. The reversing gear is of the combined steam and water cataract cylinder type, so arranged that in the event of the failure of the former the function can be performed by hand wheel and screw. The trucks

The engines have been built to the specification and inspection of Sir John Wolfe Barry and Partners, consulting engineers to the Railway, and to the requirements of the chief mechanical engineer, Mr. W. F. Gibbons.

Windmills for the Generation of Electricity.

UNTIL recently no attempt has been made in this country to investigate systematically the detail design of plant for the generation of electricity by wind power or to accumulate data for the general guidance of manufacturers of such plant. Progress in the art has, as a result, been slow. Users of other forms of motive power have at their command trustworthy figures on which to forecast the cost of generating electricity, but no such information is available in the case of windmills, and there would appear to be little doubt that this paucity of data has been the main reason for many prospective users rejecting wind power and adopting some other. Uncertainty and vagueness also prevail regarding the amount of the winds available throughout the year, the critical periods of calm and other meteorological factors affecting the problem. It is therefore evident that there is a considerable field for useful investigation in connection with the generation of electricity by wind power.

Some investigations on the subject have been conducted recently by the Institute of Agricultural Engineering, Oxford University, and the results are now available in the form of a bulletin, published by the Clarendon Press, Oxford, price 2s. 6d. The work was carried out at an experimental station, now dismantled, situated in a 17-acre field, midway between Harpenden and Luton. At this site full benefit was obtained of the winds from all directions except the north-east, in which there was some interference from trees. The scope of the inquiry covered three sections, namely, (*a*) the testing of several actual plants in order to supply their manufacturers with data as to output, general performance and suggestions for improvements; (*b*) the collection of economic data for the benefit of the public; and (*c*) the collection of meteorological data, particularly the probabilities of wind and calms.

It is pointed out at an early stage in the report that at the small heights above the ground at which windmills work the conditions of the air flow are far from steady, and are apparently capricious. A finely balanced direction vane responds fairly closely to the fluctuations in the direction of the wind stream, but a heavy pivoted mass, such as the head piece of a mill, moves sluggishly and cannot follow the changes accurately. In the usual type of windmill, in which the movements of the headpiece in the horizontal plane are produced by a tail vane or similar means of directional control, the wheel lags behind the actual change in the direction of the wind, and only for a short time is its plane truly normal to the wind stream. This fact, apart from any question of blade efficiency, reduces the capacity of the wheel to make effective use of the energy of the wind.

Again, near the ground the air flow is not stream-line, but is broken up into eddies. Even, therefore, though the plane of the wheel were always normal to the wind, the flow of the air on to and from the blades could not be assumed to be stream-line under all conditions.

In a common form of windmill the blades are made of sheet metal and are formed concave, with the concave side facing the direction of the wind. The angle between the chord of the blade and the plane of the wheel diminishes towards the outside of the wheel, and it is probable that under certain conditions the air flow at the tips is stream-line across the face of the blades. At the back of the blades, however, the air flow is not stream-line, and the effect of the negative pressure on the rear faces obtained by the use of a characteristic aeroplane wing section is lost. In certain designs of windmill blades of aerofoil section are used. In these mills the wheels are placed behind the structure supporting them, and not in front, as in the usual form. This arrangement is adopted because an obstruction behind the wheel has a much more serious effect in the formation of eddies than one in front of the wheel, and because, with the wheel behind the structure, the wheel pivots into the wind without a tail vane.

Stream-line blades of the form just referred to tend to give increased efficiency, but they are not at present universally employed because they are difficult and expensive to manufacture, and in some cases, when they are fabric-covered and require periodical reproofing, because they demand increased attention to preserve them in running order. Since the source of the power is obtained free of cost, efficiency may be held to be less important than low cost of manufacture and operation.

Passing to a consideration of the electrical requirements of a windmill plant, the report specifies the features desirable in the storage battery equipment. These batteries are intended to supply power at periods of no wind and to steady the supply which otherwise would fluctuate with the rise and fall of the wind. The batteries, it is stated, should be capable of being charged at irregular rates, of withstanding long periods of overcharge, and of working for several hours almost at the point of complete discharge and with very little charging taking place. When the output of the generator exceeds the requirements the surplus power is used to charge the battery, and when the generator output falls short of the requirements the additional power is drawn from the battery. The controlling device usually employed is a simple mercury cup device, which cuts in and causes charging to start when the generator speed increases and the generator voltage rises above that of the battery. The same device automatically cuts out when the wind falls and the generator voltage becomes less than that of the battery. By so doing, it prevents the battery discharging through the generator. A satisfactory device, it is remarked, should cut in when the generator voltage rises about 2 volts above the battery voltage, and should cut out when, and not before, the charging current reaches zero.

The size of storage battery required depends entirely upon the circumstances of each individual case. One of the most important considerations is the maximum duration of calm weather to be expected, and whether calm periods are likely to be preceded or followed by windy periods. It is pointed out that a period of calm in the

winter months is more critical than in the summer months. Two days' calm in winter when the load is heavy may demand greater storage capacity than a week of calm in summer when the load is light.

Windmills submitted by five different firms were tested at the experimental station. From the details of these mills given in the report, we extract the following particulars:—

Mill No.	Generator capacity. K.W.	Blades.	Price without battery. £	Price of battery. £
1	1·5	C.S.M.	193	150
2	0·4	C.S.M.	80	50
3	0·25	S.L.F.	120	(with battery)
4	10·0	S.L.F.	400	500
5	5·0	S.L.M.	215	200

C.S.M. = concave sheet metal; S.L.F. = stream-lined, fabric covered; S.L.M. = stream-lined, metal covered.

Each windmill was tested to obtain curves showing the output plotted against wind speed. From these curves and from a study of the average wind conditions over a year—June, 1924, to May, 1925—the total output of each set during the twelve months was determined, particular attention being paid to periods of calm weather. The following figures summarise the particulars given in the report. In connection with them it should be explained that the available output is taken at 75 per cent. of the generator output, the efficiency of the accumulators in all cases being taken at that figure. It may be objected that this figure is a high value to place on the efficiency of a lead plate accumulator, but it is to be remembered that for a considerable part of the time, when the wind speed exceeds a certain figure, the load is directly on the generator. In estimating the total annual charges, interest on the capital outlay has been taken at 5 per cent. and maintenance and repairs at 1 per cent. Depreciation of the plant has been calculated on a basis of a fifteen years' life and of the battery equipment on a basis of a ten years' life. It is noted that in most cases the lives assumed are possibly too short, but that actual experience is insufficient to assign definite values.

Mill No.	Total annual charges. £ s. d.	Available output per year. K.W.H.	Cost per B.T. unit. d.
1	48 8 11	1028	11·3
2	18 2 8	456	9·5
3	15 15 8	326	11·6
4	130 13 4	7646	4·1
5	59 4 8	3576	4·0

It is of interest to note that when the wheel of No. 1 mill was changed from one of 14ft. diameter to one of 12ft. 6in. diameter, the available output over the year was increased to 1336 K.W.H. and the cost per B.T. unit reduced to 8·7d. Similarly, when the projected blade area of the 8ft. wheel of mill No. 2 was reduced from 29 square feet to 26·25 square feet without altering the diameter, the available output rose to 684 K.W.H. per year and the cost fell to 6·4d. per B.T. unit. When, however, the height of the mast supporting No. 2 mill was reduced from 50ft. to 30ft., the available output fell to 316 K.W.H. per year and the cost per unit, in spite of the lower capital outlay and all the items of the annual charges based on it, rose to 12·7d. The same inference is to be drawn from experiments made with mill No. 3. When the post carrying this mill was increased in height from 10ft. to 20ft., the available output rose to 368 K.W.H. per year and the cost fell to 10·3d. per unit. The available output per day naturally varies with the period of the year. In the case of mill No. 1, the average daily output over the whole year was found to be 2·84 units, but taken month by month it was as follows:—January, 4·97; February, 6·54; March, 2·69; April, 2·78; May, 2·36; June, 0·72; July, 0·94; August, 0·59; September, 3·53; October, 1·79; November, 2·66; December, 4·50. It will be seen that the average daily available output is fortunately greatest in the winter months, when the demand on the plant for lighting purposes is greatest.

Reviewing the results, the report claims that the investigation shows that in places where connection to a main electric supply system is not obtainable, the generation of electricity by windmills bears favourable comparison as regards cost per unit of power with any other form of generating plant of similar size. In the larger sizes the price per unit is lower than most lighting rates, and almost as low as the power rates of several public companies, although it is not suggested that if connection to the mains of a large supply company can be obtained, a windmill plant should be preferred. In the smaller sizes the price per unit may appear high, but it is argued that it is not higher, and indeed is probably less, than the figure realised by any other form of small size generating plant.

As regards reliability and continuity of supply—a frequent cause for doubt in the minds of those contemplating the installation of an electric windmill plant—the report urges the necessity for avoiding a haphazard choice of plant. Continuity of supply, it is asserted, can be assured if the load is carefully planned to suit the set at all seasons of the year.

Those who already own an engine generating set, and desire to supersede or supplement it, should, the report concludes, have little hesitation in adopting wind power. All over the country there are engine sets which have seen a useful life and are now hardly fit for regular running, but which could be used occasionally to charge the battery. The windmill set would provide the bulk of the supply, while the engine could make good any occasional deficiency, and thus enable a smaller plant to be chosen than would otherwise be necessary.

High-pressure Water-tube Marine Boilers.

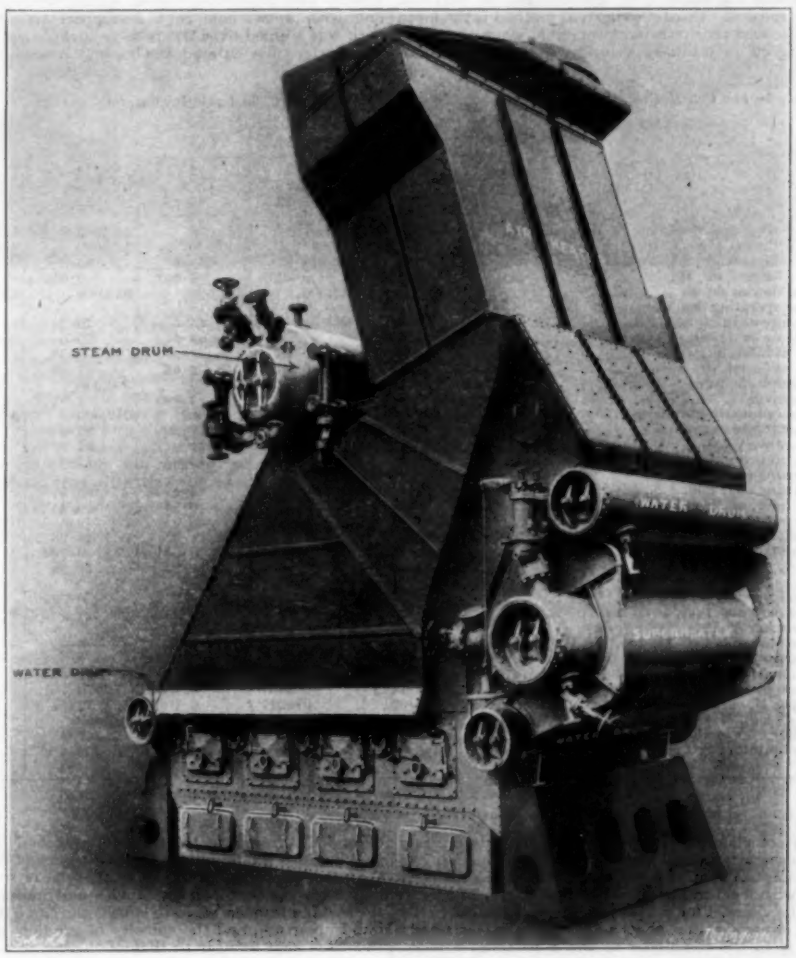
In a paper read before the spring meeting of the Institution of Naval Architects, and reproduced in a slightly abridged form in our issue of April 9th last, Mr. Harold E. Yarrow gave some particulars of some high-pressure water-tube boilers which his firm was constructing at Scotstoun. One of the boilers dealt with was of the marine type, and Mr. Yarrow explained that two of that pattern were being made for installation on a vessel then being built by Wm. Denny and Brothers for Turbine Steamers, Ltd. Accompanying the paper were drawings and half-tone engravings of the boiler, which were reproduced on pages 410 and 414 of the issue just mentioned. The half-tone engravings represented the boiler being erected in the maker's shops, and without its casing. In the engraving given herewith we are able to put before our readers a reproduction of a photograph of a completed boiler, which is to work on board the turbine passenger steamer George V.

Particulars of the boiler were given by Mr. Yarrow in his paper, but we may here repeat that each of them has a total heating surface of 3420 square feet, of which the superheating surface is 870 square feet. In addition, there are 2200 square feet of air heating surface for preheating the air prior to its admission to the closed ashpit. The working pressure is 575 lb. per square inch, that being the pressure at which the safety valves are set, and the final temperature of the steam is from 700 deg. to 750 deg. Fah. The test pressure was 913 lb. per square inch.

The boiler, which is coal-fired, consists of a forged steam drum connected to three forged water drums by means of straight tubes expanded and bell-mouthed in accordance with usual practice. Between the two water drums on the right-hand side of the boiler is a superheater, which consists of a forged drum with a number of U tubes, and which is placed between the two generating elements. The gases all pass up one side of the boiler, and through the air heater, which is situated above the boiler, to the funnel.

Mr. Yarrow explained in his paper that the reason for adopting a single-flow type of boiler, in which all the gases pass through one side, was because that design provided a somewhat better arrangement in the particular ship, in which the boilers were to be fitted, than the double-flow type, in which the gases pass equally through each side, would have afforded. The generating element on the left-hand side of the boiler absorbs a considerable portion of the heat from the furnace by direct radiation, and the proportion of the total surface of the boiler subject to direct radiation is considerable.

For further particulars of this interesting steam generator, we would refer our readers to Mr. Yarrow's paper, or to the fairly full abstract of it which is given on page 411 of our issue of April 9th. We may add that the two boilers are now fitted on the George V., and that it is expected that the latter will begin her trials within the next few weeks.



YARROW HIGH-PRESSURE BOILER FOR CLYDE STEAMER

Electric Power in Shanghai.

The report of the Shanghai Municipal Council's Electricity Department for 1925, together with the covering letter by Mr. T. H. U. Aldridge, the engineer-in-chief and manager, which we have just received, is remarkable for several reasons, and these reasons are of both a commercial and a technical nature.

For one thing it is found to be possible to supply electricity in bulk at a charge as low as 0·6d. per kilowatt-hour. Such a rate is not, of course, abnormally low for similar service in this country, but it must be borne in mind that the coal burned at Shanghai has to be carried at least a thousand miles, while the capital cost of the installation has been increased by the expense of conveying all the machinery from England. It may be said that the price of such a bulk supply is no indication of the expense to which an ordinary consumer will be put for a service, but here, again, the charges are remarkably low, the flat rate for lighting being slightly less than 4d. per unit, while the heating, cooking and domestic utility rate is 1·08d. Such low charges may be accounted for by the fact that Shanghai is densely populated, and provides a good load factor—about 50 per cent. The actual load factor for last year was 53·06 per cent., based on the units sold, not generated, as is generally the basis of calculation in this country, on account of the wide variety of manufacturing processes which go on in close proximity to the residential districts; but we believe that it is no less due to the progressive technical policy of the engineering staff.

In this connection it is noteworthy that in referring to the extensions of the power plant now being put in hand, Mr. Aldridge virtually advocates the consideration of large generating units and their boilers as separate entities, the design of which should not be hampered by any thought as to the working conditions of previously existing plant.

This conclusion is arrived at from the fact that while the present plant was designed for a pressure of 180 lb. per square inch and a steam temperature of 572 deg. Fah., the extensions, which are to be carried out in instalments of 20,000 kilowatts each, are to work at 350 lb. and 700 degrees. It will thus be impracticable to interconnect the two steam ranges, and the new large sets must stand on their own merits. There will, however, be a large degree of reserve in the extensions, as the first unit of 20,000 kilowatts is to be served by three boilers, each of which will be capable of evaporating 150,000 lb. of water per hour, while the second unit of the same size will only require the addition of one more boiler, so that there will be, at least, always one boiler as standby. *Apropos* steam conditions, Mr. Aldridge says that although the existing turbines were intended for a pressure of 180 lb. and the boilers for 200 lb., they are now running with 220 lb. on the boilers, or about 200 lb. at the stop valve, and some 600 degrees total temperature.

The extensions now in hand will have an ultimate capacity of 50,000 kilowatts, as compared with 121,000 kilowatts of established plant, and a maximum peak load of 77,000 kilowatts. Unfortunately, we have no record of the minimum daily load on the station, but it is evidently intended that the new units should be run fully loaded or not at all, and the balance of the power required supplied by the older sets. In this way the isolation of the new plant will be justified, although the older turbines still stand high in the list of thermal efficiencies.

We are not, here, much concerned with the internal finance of the Shanghai Municipal Council, but it is interesting to note that Mr. Aldridge, in typical engineering fashion, deprecates the subscription of so large a sum as £180,000 annually by the electricity department to the General Municipal Fund, and advocates the utilisation of a larger proportion of such funds for the reduction of the cost of electricity supply. It is noteworthy, nevertheless, that the new extensions will not require any additional capital except that needed for the acquisition of land.

Cleaning Blast-furnace Gases by Electricity.

SEVERAL interesting developments have taken place recently in the electrical precipitation method for cleaning blast-furnace gases, and it is found that when collecting and removing suspended particles, which do not vaporise at high temperatures, the precipitator can handle the gases hot as they come from the source. The only limiting factor is the temperature which can be withstood by the material of which the precipitator is built, whether it is brick, steel or alloy.

An interesting installation of this electrical process is at the Duluth plant of the Minnesota Steel Company, where Cottrell electrical precipitators de-tar the gas from five Morgan producers, these gases being partially scrubbed in an Ernst washer before entering the precipitator. The tar content entering the precipitator is from 0·1 to 0·2 grains per cubic foot, and the electrical process reduces it to less than 0·01 grain per cubic foot, and the de-tarred gas goes direct from the precipitator to the gas engines. The gas producers are in service only when the supply of gas from the blast-furnace fails, so that the precipitators are only used intermittently. This installation consists of a twenty-five pipe unit.

There are two types of electrical precipitation apparatus —that employing alternating current and that using direct current to maintain the electric field. When alternating current is used, precipitation can be effected, provided the gases are passing with no appreciable velocity, otherwise the effect is to agglomerate the particles into larger masses. The direct-current method is the more popular, because precipitation is possible when the gases are passing at an ordinary velocity, and the degree to which perfect cleansing is approached depends entirely upon the electric potential and the velocity of the gas.

In the simplest form of apparatus the electrodes consist of a tube with a central or axial chain or wire. The tube, which is the channel for passing the gases, constitutes the grounded electrode, and the chain, which is electrically insulated from the remainder of the apparatus, is negatively charged with a potential varying from 35,000 to 50,000 volts, which is usually derived by transforming a low-voltage alternating current to high voltage, and then rectifying it to unidirectional current. In the intense field thus created and maintained, there is a silent discharge from the axial chain to the tube. The gas passing through becomes ionised, and the suspended particles become electro-statically charged and repelled, and ultimately precipitated on the inner surface of the tube, from which they are removed by any suitable means.

The volume of gas that can be cleaned by each pair of electrodes is obviously limited by the size of the tube and the degree of dust removal desired. This, in turn, is determined by the gas velocity, the dust content and the voltage available. The handling of larger volumes of gas is accomplished simply by a multiplication of the pairs of electrodes.

This process has also been used with success for removing tar from cooled gases, and the writer is indebted to Mr. C. F. Morris for figures of tests on the removal of tar from water gas. An installation of the Cottrell process has been carried out at the Denver gasworks in Colorado, the capacity of the unit being 500,000 cubic feet of gas per hour at 30in. barometer and a temperature of from 80 deg to 100 deg. Fah. Within the specified limits of capacity the guaranteed efficiency is the removal of not less than 90 per cent. of all suspended matter in the gas. The precipitator is installed in the plant system between the secondary scrubber at the outlet of the relief holder, and the inlet to the water gas exhausters. The plant is, except on extremely low rates of flow, under a vacuum of 1in. water column.

The rated capacity of the electrical apparatus is 5 kilovolt-ampères. Mr. Morris finds, however, that the current value measured on the low side of the high-tension transformer very seldom exceeds 10 or 12 ampères at 220 volts. This makes the power consumption for the transformer less than 3 kilovolt-ampères. In addition to the power consumed by the transformer, the 1 horse-power synchronous motor that drives the rotary rectifier has to be supplied with current. This makes the total power requirement for operation between 3·5 and 4 kilovolt-ampères.

Owing to the load factor and the constant make of 160,000 cubic feet per hour of coal gas at Denver, the make in the water gas plant fluctuates over a wide range during the day. The precipitator ordinarily operates on gas flows of from 125,000 to 500,000 cubic feet per hour, without any apparent change in efficiency, as observed in operation; but during the tests the efficiency showed a tendency to fall off at the lower rates of flow. This departure from the ordinary may be accounted for in part by the fact that less water vapour, as shown by the tar distillation test, was carried over from the secondary scrubber per 1000 cubic feet of gas, when the rate of flow was decreased. Moreover, at the lower rates of flow the moisture and tar had a much better opportunity to drop out in the relief holder and secondary scrubber. It is also quite evident, according to Mr. Morris, that the smaller the quantities of impurities in the foul gas the harder it is to remove a high percentage. The cleaned gas on the lower rates of flow compared quite favourably in grammes of tar per cubic foot with the higher rates of flow.

The apparatus used in conducting the test consisted of the following details:—One cotton-packed absorption tube, three water gauges, one wet type test meter, one motor-driven small size Roots exhauster, and the necessary glass and rubber tubing. The absorbing tube was made up of a glass tube, 1in. in diameter and 12in. long, filled loosely with absorbent cotton, tightly stoppered at each end with a two-hole rubber stopper. A third rubber cork was slipped over the tube to make a gas-tight joint where the tube entered the main. A small glass tube extended through both the stoppers and the cotton packing into the main to provide a means of determining the main pressure. Another small tube of 0·1in. inside diameter was bent at right angles and inserted through the stopper into the main to collect the gas. Its open end faced upstream, and the velocity of gas flow through the tube was kept as near to that of the gas in the main as possible. A short glass tube was inserted in the remaining hole of the stopper outside the main to draw the gas through the meter and exhauster.

The duration of each test was about two hours, but it was not found possible to obtain a test to determine the efficiency of the unit at its maximum rating. The absorbent cotton and tube were very carefully weighed on an analytical balance before and after the gas had passed through them. At the start of the test meter readings, rates of flow, temperatures and pressures were noted and were taken every ten minutes during the test.

The tar and water overflowing from the precipitator during the test were carefully measured, and a sample of the tar was dehydrated to determine the tar content of the precipitate on a dry basis. Great care was taken in making all gas connections to prevent air sucking into the line ahead of the meter. A sample of gas was taken at the outlet of the exhauster during each test and analysed to determine if the composition of the gas showed any leakage of air into the lines ahead of the meter. All the gas volumes were computed to 30in. Hg and 60 deg. Fah.

The method used in calculating the efficiency is as follows:—

Gas passed through the tube, 11·12 cubic feet, standard conditions.
Gain in weight of tube and cotton, 0·3790 grammes.
0·3790 ÷ 11·12 = 0·034 grammes of tar and water per cubic foot in the purified gas.
Gas flow through precipitator in two hours = 574,000 cubic feet.
Tar and water removed by precipitator = 64·5 gallons.
Specific gravity of precipitate = 1·0237.
64·5 × 8·33 × 1·0237 × (100 ÷ 2·21) = 249,000 grammes.
249,000 ÷ 574,000 = 0·434 grammes of tar and water removed per cubic foot of gas.
0·434 + 0·034 = 0·468 grammes of tar and water per cubic foot of foul gas.
0·434 ÷ 0·468 = 92·7 efficiency of removal.

Efficiency Test on Cottrell Precipitator. Capacity 500,000 Cubic Feet per Hour at 80 deg. to 100 deg. Fah. and 30in. Barometer.

Test	1	2	3	4	5
Duration, hours	2	1·3	2	2	2
Weather	Clear	Raining	Clear	Clear	Clear
Barometer, in., Hg	24·93	25·22	25·20	25·22	25·20
Bailey meter data—					
Average rate of flow per hour, cu. ft.	292,660	255,000	290,000	260,000	127,000
Total flow during test, cu. ft.	585,320	340,000	580,000	520,000	254,000
Average temperature, deg. Fah.	96·5	74·5	74·5	93·0	83·6
Average pressure, in., Hg	0·627	0·635	0·642	0·612	0·529
Corrected flow at 60–30	574,000	342,000	582,000	513,000	252,000
Precipitator operating conditions—					
Temperature at inlet, deg. Fah.	71·8	68	65·5	70·5	72
Temperature at outlet, deg. Fah.	74·5	67	68·5	73·5	75
Pressure at inlet, in., water	−1·0	−0·36	−1·21	−0·52	2·35
Pressure at outlet, in., water	−1·39	−0·80	−2·68	−1·68	2·20
Total precipitate, in c.c.	242,000	142,800	291,020	309,230	46,570
Specific gravity	1·0237	1·0325	1·005	1·01	1·035
Total precipitate, in grammes	249,000	147,500	292,500	312,300	48,200
Total precipitate in gallons	64·5	38·9	77·2	82·5	12·7
Per cent. water	19·0	19·5	21·0	27·0	3·5
Ampères on precipitator	10·0	10·0	12·0	12·0	12·0
Meter operating conditions—					
Temperature, deg. Fah.	93·2	69·9	74·4	83·5	76·0
Pressure inlet, in., Hg	—	−0·4	−0·54	−0·4	−0·1
Pressure outlet, in., Hg	−0·31	−0·4	−0·54	−0·4	−0·1
Cubic feet, metered	15·117	9·2	14·33	13·98	10·2
Correction factor, 60–30	0·736	0·801	0·801	0·763	0·796
Cubic feet, metered, 60–30	11·12	7·36	11·25	10·69	8·12
Sample—					
Grammes collected	0·3790	0·5375	0·6422	0·3955	0·5028
Grammes per cubic foot, at 60–30	0·034	0·073	0·0571	0·037	0·062
Results—wet, at 60–30—					
Grammes per cubic foot, inlet	0·468	0·5235	0·5601	0·64	0·254
Grammes per cubic foot, outlet	0·034	0·079	0·0571	0·037	0·062
Per cent. matter removed	92·7	85·6	89·0	94·3	75·6
Precipitate per M. cubic foot, gallons	0·1123	0·1137	0·1330	0·161	0·0504
Dry tar per M. cubic foot, gallons	0·091	0·0917	0·1051	0·1175	0·0487
Total day's run, M. cubic foot	3,850	3,850	3,860	3,860	—
Total gallons tar removed, dry	350·35	352·04	386·77	432·0	—
Total precipitate, day's run, gallons	432·56	433·90	489·4	292·0	—

NOTE.—In Test No. 2 naphthalene crystallised out in sampling tube.

The accompanying table shows in detail the data collected and the results obtained in five tests. The efficiency from a visual standpoint could be perceived quite readily from tar pictures taken at the inlet and outlet of the precipitator.

Institution of Naval Architects.

As already announced, the Summer Meeting of the Institution of Naval Architects will be held in Belgium during the present month. The following programme has been arranged:—

On the morning of Monday, June 21st, the party will proceed from London to Brussels, *viâ* Ostend, and in the evening there will be an informal Reception at the Fondation Universitaire, Brussels.

On the Tuesday morning an opening ceremony will take place at the Palais des Académies, when the Diploma of Honorary Membership will be presented to H.M. the King of the Belgians. The following papers will then be discussed:—

(1) "The Belgian Mercantile Marine," by Monsieur A. Pierrard;

(2) "A Comparison between Steam and Diesel Machinery for Cargo Vessels," by Sir John Biles;

(3) "Inclining Experiments with Ships of Small Initial Stability," by Professor Wm. Hovgaard.

In the afternoon a visit will be paid to the Royal Palace of Laeken, and in the evening there will be a reception at the Hôtel de Ville by Burgomaster Max and the Civic Authorities.

On the Wednesday morning there will be alternative visits to:—(*a*) The battlefield of Waterloo by motor; and (*b*) the University Buildings; and in the afternoon a visit will be paid to the Colonial Museum at Tervueren, where tea, at the invitation of the Société des Ingénieurs et Industriels, will be partaken of. In the evening the party will attend a performance at the Théâtre de la Monnaie.

On the Thursday morning the party will travel by motor from Brussels to Antwerp *viâ* Louvain and Malines, and in the evening there will be a banquet in the Chantilly Restaurant, Hôtel Terminus, Antwerp, given by Burgomaster van Cauwelaert and the Civic Authorities.

On the Friday morning there will be a business meeting at the Ecole Normale, Rue Quellin, Antwerp, when the following papers will be discussed:—

(4) "A Description of the Antwerp Docks," by Monsieur Bollengier;

(5) "Oil Separators for Bilge and Ballast Water," by Dr. H. S. Hele-Shaw and Mr. A. Beale;

(6) "Some Ship Strain Observations," by Mr. J. Lockwood Taylor.

Luncheon will be taken at the Zoological Gardens Restaurant at the invitation of the Antwerp Ship Repairers' Association. In the afternoon visits will be paid to the Plantin Museum and the Art Galleries, and tea will be given by Mayor and Madame Beliard, at 83, Rue de La Morinière. In the evening there will be a Reception and Dance given by the Governor of the Province, Baron Holvoet.

On the Saturday morning a visit will be paid to the Antwerp Docks and in the afternoon there will be alternative visits to:—(*a*) The Dock extension works by steamer; and (*b*) the golf and polo grounds at Cappellenbosch, where tea will be given by Mr. and Mrs. Petrie. In the evening a banquet will be given by the Institution at the Zoological Gardens Restaurant.

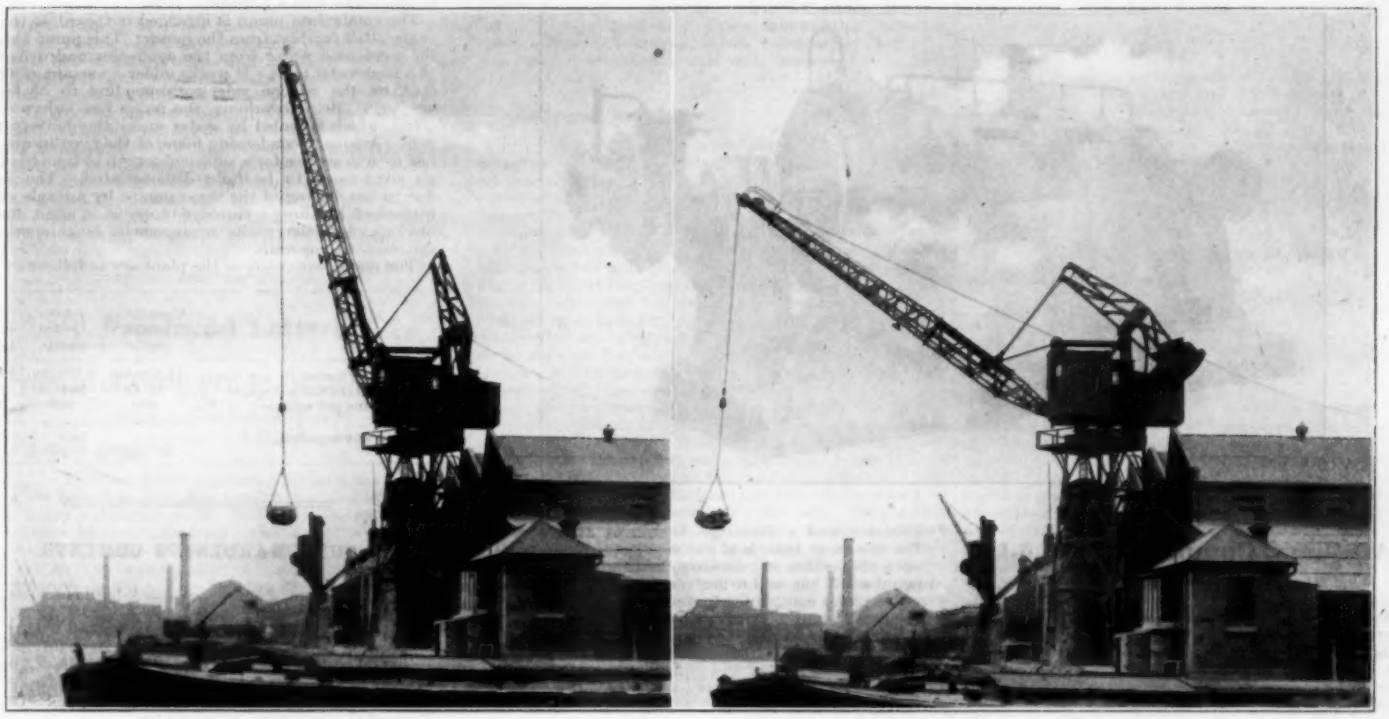
On Sunday, June 27th, the party will proceed by special steamer from Antwerp to Dover, stopping at Zeebrugge for a visit to the Mole and Museum and the unveiling of a Memorial Tablet.

Sixty Years Ago.

WHEN we listen to "to-night's weather forecast" how many of us are aware of the brilliant versatile career and sad ending of him to whom more than to any one else our generally admirable meteorological service owes its origin? An article on "The Board of Trade Storm Signals" in our issue of May 25th, 1866, arrests our attention with its challenging references to Admiral Fitzroy, and has prompted us to a study of his life and achievements. Fitzroy, 1805–1865, joined the Navy as a cadet in 1819. By 1828 he was commander of the Beagle, engaged on survey work in South American waters, and in 1831 he sailed in that ship for a further five years' survey cruise, the memorable cruise in which Charles Darwin took part. In 1841 and 1842 he tried for and obtained parliamentary honours. In 1843 he was appointed governor of the newly established Colony of New Zealand. In spite of a recent massacre by the natives, he sympathised with them too openly to please the colonists, and, as a result of repeated petitions, he was recalled in 1845. Three years later he was appointed superintendent of Woolwich Dockyard, and in 1849 became commander of the Arrogant, an early screw frigate, with which important experiments were conducted. In 1850 he was placed on retired pay, and in 1851 he was elected a Fellow of the Royal Society. In 1854, after a short period as private secretary to the Commander-in-Chief of the Army, he was selected by the Board of Trade as its first "meteorological statist." Into the study of weather phenomena he threw himself with ardour, for it was a subject by which, since his days in the Beagle, he had been greatly attracted, and simultaneously he exerted himself strenuously in the interests of the Lifeboat Association. His health, bodily and mental, threatened to give way, but he refused to rest, and, in a fit of aberration, he put an end to his existence in April, 1865. The article in our issue referred to, although it is silent on these details of Admiral Fitzroy's life, throws further light on his temperament. It was a review of a parliamentary blue-book giving the findings of a committee of three appointed to inquire into the working of the Board of Trade's meteorological department. With gentle scorn we criticised the committee for placing all responsibility

1½-TON LEVEL-LUFFING JIB CRANE

THE BEDFORD ENGINEERING COMPANY, BEDFORD, ENGINEERS



for the defects of the department on Fitzroy's shoulders. But we could not escape the conclusion that the Admiral, in evolving his system of weather "forecasting"—the word was one of his own coining—had acted very much on his own initiative and that the system was based entirely on empirical methods, which were little more scientific than the foretelling of events by the witches of old from the pricking of their thumbs. Of forty-seven storms in 1863 only ten were predicted by the weather forecasts. The system of weather foretelling, with which not only England but all Europe had been ringing, was, when investigated, found to be only a little more reliable than the "forecastings" of Messrs. Moore and Zadkiel. The days of weather forecasting, it was suggested, were over in all probability. If they were to be continued the head of the meteorological department should be equipped with a flowing robe and a black skull-cap, and should conduct his operations from a chamber duly supplied with a hanging crocodile, a gleaming sword, and a grinning skull. Weather foretelling has now, thanks to wireless telegraphy and the co-operation of ships at sea, been placed on a definitely scientific basis. But even before it reached its present stage of development, the value of Fitzroy's early work had become fully recognised, and the contemporary verdict upon it discredited.

A New Type of "Toplis" Level-Luffing Crane.

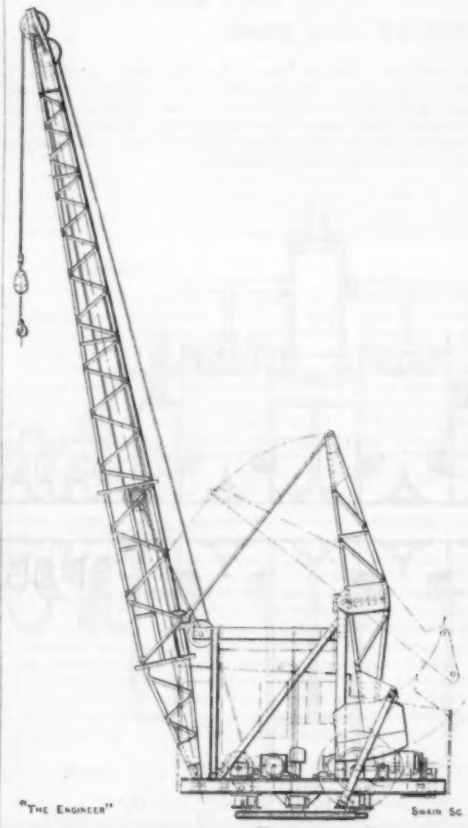
APART from the saving of power effected, if a crane be fitted with a level-luffing arrangement, the operator can judge more accurately the path of his load when working cargo rapidly, so that time is saved and greater confidence is engendered.

We illustrate in the accompanying engravings the latest development in level-luffing cranes, which has been constructed by the Bedford Engineering Company, Bedford, under the recent patent of Mr. Claude M. Toplis, and who is now associated with the firm. This crane was built to the order of the Associated Portland Cement Manufacturers, Ltd., and has been installed at that company's Hollicks Wharf, East Greenwich, where it is employed chiefly to handle cement in bags from barges to storage.

The capacity of the crane is 1½ tons at a maximum radius of 54ft., and the jib is capable of luffing up to a minimum radius of 20ft. In order to secure adequate clearance for the tail of the crane, it was mounted upon a structural steel tower, 31ft. high, with portal openings in the base to cause as little obstruction upon the wharf as possible. The top of the tower is provided with a platform, to which access is obtained by ladders in the usual way. The superstructure of the crane is constructed entirely of rolled steel sections, and the lay-out of the machinery is as simple as possible so as to facilitate access and inspection. The whole of the machinery is enclosed in a cabin, to which an extension at the left-hand side of the jib is fitted to accommodate the driver and control gear, and to afford a clear view of all the operations of the crane.

The jib, which is of the lattice-braced cantilever type is balanced by a weighted cantilever, pivoted to the top of the superstructure A frame, and connected to the jib by links. The centre lines of the jib and the balancing cantilever are parallel, so that a fixed balance weight will balance the jib in all positions. The makers point out that a further advantage of this construction lies in the fact that, as the jib is luffed outwards, the balance weight is simultaneously moved to a greater distance behind the centre line of the crane, thus compensating for the increasing moment due to the jibs weight, with the result that the movement of the centre of gravity of the crane, whether loaded or light, and throughout the range of luffing movement, is comparatively small compared with that of cranes of the usual construction.

The luffing motion of the crane is of the crank-operated type. One of the luffing cranks will be seen projecting from the cabin in the half-tone engraving. Each of the luffing cranks is coupled by a connecting-rod to the balancing cantilever. The length of the crank arm is sufficient to move the jib through the desired luffing range, and the makers claim that with this construction overluffing



ARRANGEMENT OF LEVEL-LUFFING CRANE

is impossible, and, in fact, that luffing could be continuous without detriment. No limit switches are required in any case. The luffing motion secured is a harmonic one, giving smooth acceleration and retardation at each end of the travel, which prevents swinging of the load when luffing.

It will be noted that the jib is supported and moved by comparatively rigid tie-rods. Here, again, the makers claim that this construction compares favourably with others wherein the jib is supported entirely by wire rope, which gives an undesirable "liveliness" to the jib when handling cargo at a rapid rate. In less exacting service the springiness would not be detrimental, but in cargo handling it has a definite effect upon the speed at which the work could be accomplished.

To turn now to the arrangements which are provided to compensate for the rise and fall of the jib head so as to insure that the lifting hook itself shall follow a horizontal path when luffing. It will be seen that at a point on the superstructure framing immediately above the jib foot there is a pin which supports not only the guide sheave for the hoisting rope, but also two radiating links. The other ends of these links are threaded upon a pin or shaft, which carries, in addition, two rollers that run upon a straight track provided in the jib structure. The same pin carries a second guide pulley for the hoisting rope. It will be gathered that, with this construction, the free end of the radiating links travel up to the centre line of the jib when the latter is luffed from the maximum to the minimum position.

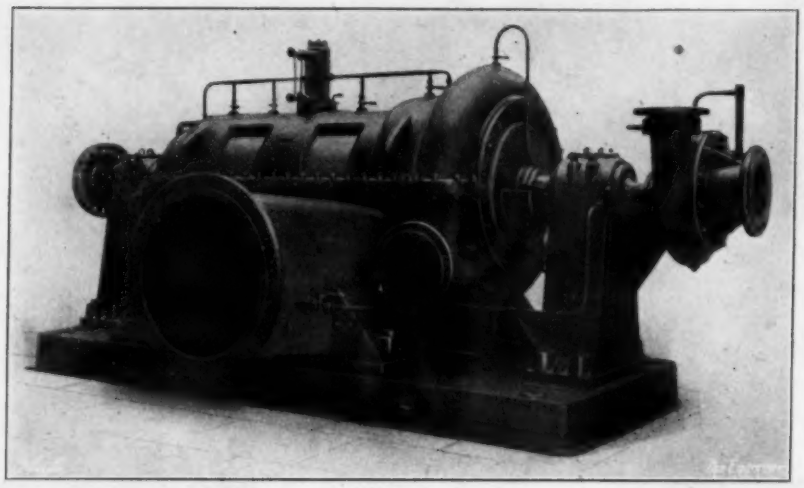
The hoisting rope from the barrel is passed over the guide sheave in the superstructure frame, thence to the jib head, then down around the moving guide sheave at the end of the radiating links, back over the jib head and down to the load hook. The moving guide sheave is thus enclosed in the bight of the hoisting rope, and the arrangements are such that as the jib swings inwards, the upward movement of the guiding sheave pays out just sufficient hoisting rope to compensate for the natural rise of the jib head and level luffing results. As a matter of fact, so we understand, the compensation is found to be very exact, and that over a range of 30ft. or more no appreciable error is observable.

We are informed that, owing to the careful balancing of the jib in this crane, and to the exactitude of the level luffing feature, the power consumption in luffing has been found to be very small indeed, the work which the motors have to perform being chiefly to overcome inertia at the beginning of the movement. The speeds provided are as follows:—Hoisting, 130ft. per minute; slewing, 1¼ revolution per minute; luffing, average speed, 100ft. per minute. All three motions are separately operated by "Maxtorq" motors constructed by the Lancashire Dynamo and Motor Company, Ltd., and arranged for a two-phase four-wire circuit 200 volts 50 periods. The controllers, which are of Messrs. George Ellison's manufacture, are adapted to switch the motor direct on to the line without resistance in the case of the hoisting and luffing motors, but in the case of the slewing motor it was found desirable to provide two stops, the first stop putting the motor on the line through a choking coil, and so as to reduce the rope acceleration, which would otherwise be obtained, and which would result in swinging of the load. The crane panel is of the contactor type, and was constructed by Allen West and Co., Ltd.

THE output of energy from the Yallourn (Vic.) and Newport "B" generating plants combined has, according to the *Industrial Australian*, now reached a total of 627,000 kilowatt-hours in a single day, and more than 15,000,000 kilowatt-hours were received at the Yarraville terminal station in the month of March. This quantity exceeded that for the corresponding period of the previous year by more than 50 per cent., and it is anticipated that the following year will exceed the present year for the same period by at least the same proportion. Works are being pushed forward in order to supply the greater portion of the area served by the Melbourne Electric Company by the end of the year. Additional electric circuits are being arranged between the Yarraville terminal station and the South Melbourne sub-station, crossing the Yarra by two steel towers, each 250ft. high. A number of additional high-pressure sub-stations, with high-pressure connecting mains, will complete these works.

COMBINED AUXILIARY PUMPS FOR STEAM TURBINE

SULZER BROTHERS, LUDWIGSHAFEN, ENGINEERS



Auxiliary Pumps for 30,000-kw. Steam Turbine.

At the recent technical Fair at Leipzig, Messrs. Sulzer Brothers exhibited an imposing example of their latest design of auxiliary plant for large steam turbines. We illustrate above and by Fig. 1 a plant of the kind in question, constructed by Messrs. Sulzer at their Ludwigshafen works for use in connection with a three-cylinder steam turbine of 30,000 kilowatts, built by Messrs. Brown, Boveri and Co. for the Tschechnitz power station of the Elektrizitätswerke Schlesien Aktiengesellschaft. As will be gathered from the drawing, the circulating water pump, the air ejector pump and the condensate pump are all mounted on a single shaft, which is arranged for direct coupling to a 600 horse-power three-phase Brown Boveri motor running at 960 revolutions per minute.

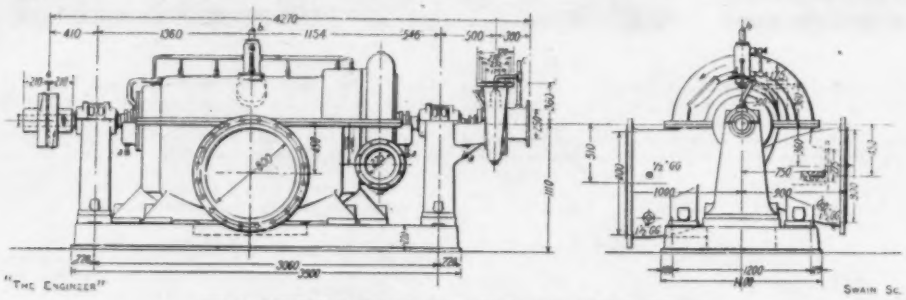


FIG. 1—AUXILIARY PUMPS FOR 30,000 K.W. STEAM TURBINE

The circulating pump has an inlet branch of 35·43in. diameter and a discharge branch of 31·5in. diameter. The discharge branch of the air ejector pump is 10·9in., while the suction and discharge branches of the condensate pump are 9·8in. and 6·9in. respectively. The circulating water pump constitutes by far the largest portion of the combined plant. Three impellers are used on the Tschechnitz plant to supply the total quantity of water to be handled, namely, 11,020,000 lb. per hour at a total head of 52·49ft. The sectional drawing—Fig. 2—shows a circulating pump having only two impellers, but the same principle of construction is employed when three are used. The water enters the impellers from the suction chambers at the side of each impeller and is discharged into a common pressure chamber.

The air ejector pump, which is arranged at the side of the circulating water pump, takes its water from the pressure chamber of the latter. The pump shown in the sectional drawing is of the two-stage design, but either one or two stages are used according to the pressure head required in any particular case. It will be noted that no separate section pipe is required for the ejector pump. The delivery water entrains the air from the condenser and maintains the vacuum at the required value. In the design illustrated by the half-tone engraving, it will be noted that both the circulating pump and the ejector pump are contained in a common housing constructed in two parts with a horizontal joint.

The condensate pump is arranged outboard at the end of the shaft furthest from the motor. This pump extracts the condensed water from the condenser and delivers it to a feed-water tank. It works under a vacuum of 96 per cent. on the suction side, corresponding to 28·8in. of mercury. Being overhung, the pump has only a single gland, which is sealed by water under the delivery pressure. Auxiliary condensing plant of the type in question has been in service for a sufficient length of time to enable its advantages to be fully demonstrated. The saving due to the driving of the three pumps by a single motor, instead of by three separate motors, as is often done, is obvious, and the whole arrangement is compact and convenient to operate.

The main particulars of the plant are as follows :—

	Circulating water pump.	Air ejector pump.	Condensate pump.
Delivery of water, lb. per hour..	11,020,000	1,102,000	352,640
Total head, in feet, of water ..	52·49	144·36	77·1
Revolutions per minute	960	960	960
Total power required, H.P. ..	546		

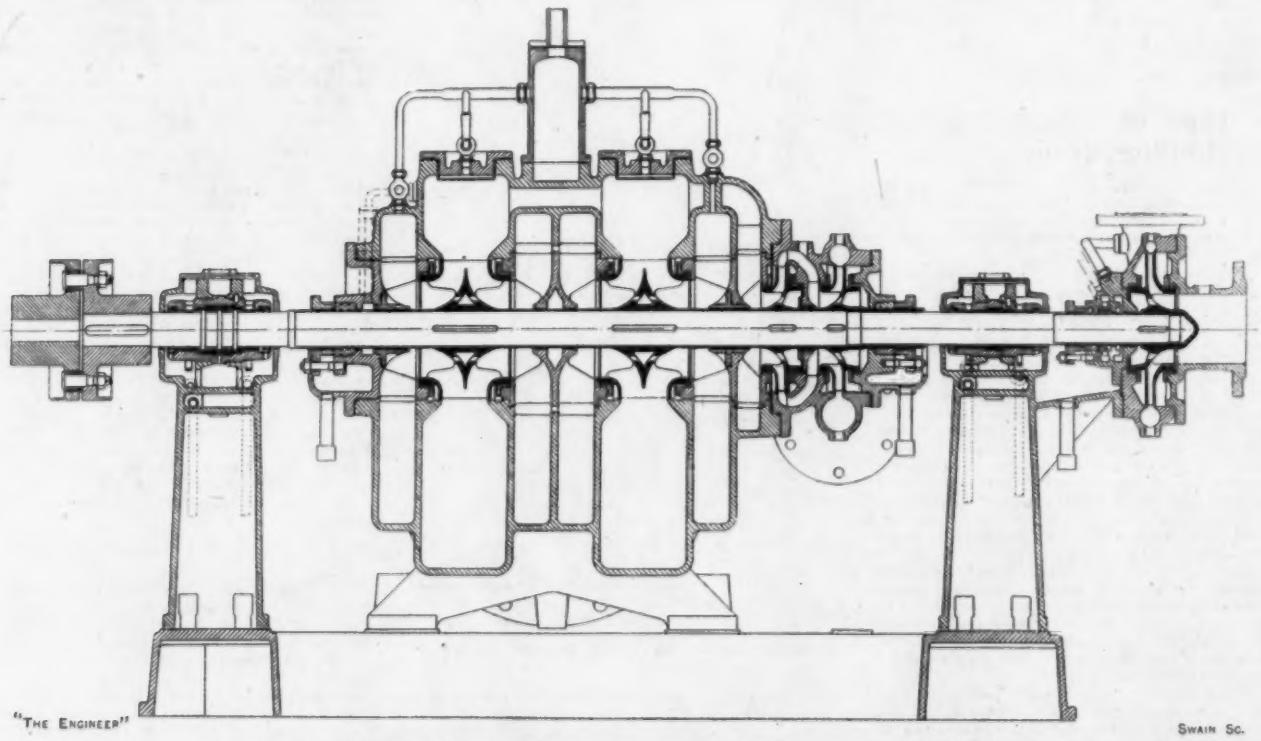


FIG. 2—COMBINED AUXILIARY PUMPS WITH TWO CIRCULATING WATER IMPELLERS

QUICK-HARDENING CEMENTS.

Discussing the question of quick-hardening cements, our Canadian contemporary, the *Contract Record and Engineering Review*, in a recent issue quoted from a communication from the Portland Cement Association to the President of the Associated General Contractors of America, in which the possibility of obtaining a compressive strength of 3000 lb. per square inch in three days is pointed out. Parts of this letter are as follows :—

"Recognising the need for high early strength concrete, our laboratory has been giving some considerable study to this subject, having in mind, of course, the use of normal Portland cement in such a way as to produce the results desired. We feel that in many cases the need for high early strength concrete will be met by Portland cement concrete so proportioned, mixed and placed as to produce the desired result.

"For example, let us assume concrete having proportions of one part of cement, two parts of sand, and four parts of pebbles or stone, usually considered to have a strength of 2000 lb. at twenty-eight days. On the average job this concrete would be mixed with about eight gallons or more of water per sack of cement, and under ordinary conditions with a mixing time of one minute, would produce a strength at three days of approximately 750 lb. per square inch. By cutting down the amount of water from around eight gallons per sack to six gallons per sack, giving concrete having a slump of 1in. instead of 6in. or 7in., the strength of concrete of the same proportions would be increased from 750 lb. to 1350 lb. per square inch.

"Let us now increase the richness of the mix to, say, 1 : 1½ : 3. Such a mixture would permit us to cut down the amount of water to 4·4 gallons per sack of cement, and still maintain the same workability, that is, a 1in. slump. The strength of this concrete would be increased by this change from 1350 lb. per square inch at three days to 2410 lb.—these are, of course, average figures, and based

on the use of aggregates available in the Chicago market.

"Now, if we increase the mixing time of this concrete from one minute to five minutes, we can, according to our studies, increase the strength from 2410 lb. to 2860 lb. per square inch. If, now, we add 2 per cent. of calcium chloride to the mixture, we can produce a concrete having a strength of probably well over 3000 lb. per square inch at three days or 1½ times the strength of ordinary concrete at twenty-eight days. Adding calcium chloride is placed last in this process, and its effect not given too definitely, because apparently the effect of its use with all brands of cement is not the same.

"It then becomes a question whether the contractors want to take precautions above outlined to produce high early strength with Portland cement, or purchase special cement for the purpose. I have no information as to the relative cost. The point I wish to make is that there is available to the contracting fraternity in this country a high early strength cement or means by which this high early strength can be produced with Portland cement."

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Activity Strangled.

THE fuel question is becoming increasingly acute, and the dearth is gradually obtaining a strangle hold on the heavy industries of the Midlands and Staffordshire. Very few blast-furnaces are blowing, sheet mills have succumbed, ironworks are only partially employed, and the few steel mills in operation are using for the most part continental billets. The amount of material available has shrunk rather pronouncedly, and at to-day's weekly meeting of the Midland iron trade business was almost stagnant. The amount of inquiry passing indicates a healthy demand, of which iron and steel makers would be glad to take advantage. It is obvious, however, that no improvement can be looked for until work is resumed at the pits and ample fuel for all purposes is once again available. Those who have stocks of material for disposal are selling at a premium, but many works are now on short time, and their requirements are not large. In the Black Country this week the position has been eased somewhat by the restarting of the skelp mills at Messrs. Alfred Hickman's Spring Vale Steel Works, and it is understood that an effort will be made to keep the mills going so long as a supply of billets are available. All departments of the King's Hill Foundry of Messrs. Samuel Platt, of Wednesbury, have also resumed operations this week. How long they will be able to continue rests with the supply of electric power and coal.

Engineering Position.

The lack of fuel supplies is now beginning seriously to affect many Birmingham and Midland industries, apart from the iron and steel producing works, which have been in queer street almost since the miners ceased work. This week many engineering establishments have been forced to work even shorter hours as stocks of coal, even used at the rate of half usual consumption, are being so heavily depleted. The position in the allied trades is gradually becoming worse, but some branches continue to carry on without interruption. So far activities have not been interrupted at the structural engineering yards. A moderate amount of work is in progress, and the prospects are considered hopeful if only relief from labour and market disturbance can be obtained. Works managements have to carry on chiefly with such stocks of raw material as they have by them. It is obvious production cannot be long maintained on this footing. In the electrical engineering establishments and in related branches of mechanical engineering, works were fully employed before the strike, and they have plenty of orders to occupy them now. Here, fortunately, no immediate difficulty threatens with regard to raw material. The heavy engineering industries of South Staffordshire have been hard hit by the strike, and a large number of concerns requiring a regular supply of fuel are closed down, and will be unable to resume until the pits are open again.

Rolling Stock.

The general stoppage and the miners' strike have caused considerable dislocation at the Midland rolling stock establishments, and it will take some time to get the shops into normal running order again. Work has been resumed in all departments so far as the Birmingham area is concerned. But with the increasing difficulty of reinforcing raw material resources, there are misgivings as to the balancing of output. Home railway companies' orders have in recent years been a great help to builders of rolling stock, and the latter are worried as to how enterprise may be affected in the near future by the heavy loss of revenue which the railways are suffering. The demand for private owners' wagons has been stagnant for some time past, and there is no hope of a change for the better in this quarter till coal can be marketed at a price which will stimulate consumption.

Trade Returns.

The returns of exports and imports of iron and steel over the month of April make uncomfortable reading, and industrialists in this area are asking what the May returns are likely to show. Iron and steel products shipped to overseas buyers in April realised a little over 5 millions, a drop of more than 1½ million on the March figures. The tonnage in April was the smallest of any month this year, being nearly one-fourth below that for March. While exports of iron and steel were so falling, imports continued to increase. In January imports totalled 221,663 tons, February 228,538, March 258,526, April 261,787. Fortunately, there were one or two bright features in the returns. Some descriptions of material were sold in increasing quantities. Whatever hopes these exceptions inspired are extinguished for the time being, however. General plants are now idle, and distribution of the pre-strike output was impeded during the greater part of last month by transport dislocations. Those departments in which the slump reflected in the April returns was most severe, were:—Galvanised sheets, down one-third; thin plates and black sheets, tonnage halved; tin-plates, &c., down one-fourth; wrought tubes, pipes and fittings, down one-fourth; pig iron, down nearly one-third; and wire, decreased from 7173 to 4620 tons.

Business in Steel.

The struggle to maintain steel production is doggedly persisted in. Plate mills, which are running intermittently in South Wales, are helping Birmingham constructional engineers, and sections are also coming forward in quantities which, though not large, afford welcome relief. There is a demand for much more structural material than can be procured. There are a remarkable number of mills of small or medium capacity still at work. A fairly large aggregate is operating in the Black Country producing almost every description of steel. Such products as angles, strip, bars and small sizes of most descriptions are being turned out in good quantities. This strike differs from its predecessors through the larger use now made of electric power for driving, and a considerable proportion of heating is done by means of producer gas using fuel economically in Siemens or other plant. A fair number of mills in the Staffordshire district are at work, producing strip for tube making, and this material finds a ready sale in Birmingham and the district. It has assisted some of the local concerns to maintain production; but coal scarcity is now affecting the tube mills, many of which still heat their metal with raw fuel. Many sellers of steel have this week demanded advances ranging from 2s. 6d. to 10s. per ton. Apparently, there is no reason for conceding the larger increases, in view of the number of mills still turning out standard sizes. Most business, however, is done at a premium. Foreign steel works are making a useful harvest out of the strike, and supplying fairly heavy quantities of billets, slabs, sheet bars, &c., the price of which is low as the result of the depreciation of the franc. The ability to buy foreign steel in sufficient quantities will no doubt extend the operations of many local mills. The severe fall in the franc has enabled billets to be bought as low as £5 4s. delivered, as against the English price of £6 2s. 6d. to £6 5s. There is plenty of evidence that a good demand exists for steel and that it is likely, when work is resumed, to maintain the pre-strike scale of production.

Pig Iron.

The iron trade is disabled by the coal stoppage. Very few blast-furnaces are working. Of the 147 furnaces that were in commission at the end of April, the majority have been damped down. Most of the Midland plants are idle, and have very little stocks to offer. Northamptonshire and Derbyshire furnaces which can promise delivery of emergency supplies have no difficulty in obtaining an advance of from half a crown to 5s. per ton on pre-strike prices. The amount being disposed of, however, is insignificant. Foundrymen have had quite a crop of orders since the collapse of the general strike. They are in difficulties, however, both as to coke and pig iron. On 'Change in Birmingham to-day small sales of Derbyshire No. 3 foundry were made at £3 10s., and Northamptonshire at £3 7s. 6d. East Coast hematite could be bought at £3 13s. to £3 16s. at furnaces, and consignments are coming into this district for the service of foundries which are still carrying on. Stocks of coke have been greatly depleted. Reinforcements have been got from the North, however. Several pipe foundries are kept going in the Midlands.

Finished Iron.

The finished iron trade in Staffordshire is virtually at a standstill. The only mills running are those which have adapted their plant to the re-rolling of steel. Makers of marked bars have but few orders on their books, and the small sales effected this week have been of material from stock. The recent ruling figure of £14 is maintained. There is no business passing in Crown quality iron, while nut and bolt bars are equally quiet. What material is being worked up is chiefly of continental origin. A little business is still being done in tube strip, many of the tube mills in the Black Country continuing in operation; £12 10s. is readily paid for this material.

Galvanised Sheets.

Stocks of galvanised sheets in makers' hands are not exhausted, and are being readily sold at the increased price of £15 10s. to £15 15s. for 24 gauge corrugateds. Offerings at the former figure are not very free, better terms being required by most sellers. Quotations do not suggest severe market tension, the dislocation having supervened upon a sharp slump in the export trade. The exports of galvanised sheets for April show a substantial falling off, but they indicate a good wide-world business, and there are still enough orders coming forward to ensure full activity when the fuel supply makes this possible.

Scrap.

Scrap steel finds practically no demand, and the inability of users to take deliveries is a serious matter for merchants, who have to pay fairly substantial charges for trucks of material warehoused or *en route*, although it is possible that some concession may be made by the railway companies, in view of the exceptional circumstances.

£12,000 Stourbridge Water Scheme.

The Stourbridge Water Board proposes to spend £12,245 in sinking of bore-holes and other works. At the Coalbournbrook pumping station at Amblecote, where there are now two bore-holes, it is proposed to sink another one to a depth of 275ft. to replace one with a depth of 130ft. With the object of increasing the yield, a new bore is to be made at the Mill Meadow pumping station, to a depth of 250ft., whilst at the Tack pumping station it is proposed to deepen one of the holes. As the present rising main through Wordsley is considered inadequate for future requirements, it is proposed to provide a duplicate and more direct main. It is stated that the increased depth of the bore-holes would increase the yield of water to the full capacity of the plant—2,000,000 gallons per day—and would improve the quality of the water.

Ironworkers' Wages.

The wages of ironworkers in this area regulated by the sliding scale under the Midland Iron and Steel Wages Board are to remain unaltered from Monday, June 7th, 1926, to Saturday, August 7th. This comes as a welcome relief to the men who have experienced five successive reductions, ranging from 2½ per cent. to 5 per cent. Puddlers' remuneration for the next two months will be at the rate of 50 per cent. above the basis rate of 13s. 6d. per ton.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

OUTWARDLY, judging by the attendance on the iron and steel markets on 'Change here, there has been the usual spirited resumption of commercial activity after the Whitsuntide break, but it is only superficial, for under existing conditions business of any serious consequence is out of the question. The markets, generally speaking, are submitting to the enforced idleness philosophically, and at each session after current developments have been disposed of by way of discussion, cricket and holidays become close rivals as topics of interest. Some of the engineering firms in the Manchester district are worse off than others from the point of view of coal supplies, but most of them are carrying on fairly satisfactorily, particularly as supplies of electrical power up to the present have not been seriously affected. In constructional engineering there is a fair amount of activity, but it is unfortunately the case that much of the work is being held up because of the difficulty now being experienced in securing supplies of steel materials. An important addition to the work in hand is the contract secured by a local firm, Edward Wood and Co., Ltd., of the Ocean Ironworks, Salford, for the erection of the steelwork at the new works of the Michelin Tire Company, at Stoke-on-Trent. It is natural, perhaps, that the engineering trades' own domestic troubles should have taken a back place during the last few weeks, but the demand of the employees for increased wages is coming to the front again in view of the approaching national conference at York. In spite of the general strike experience it has been stated here this week by a trades union official that the men are as firm as ever in their attitude to the wages question.

Non-ferrous Metals.

Although in no section of the non-ferrous metals market is there much activity, the tone latterly has been steadier all round. In the case of copper the home demand naturally is still seriously affected by the prevailing conditions, while the Continent also is absorbing very much below normal, although the German position is improving somewhat. The consumption in America, however, is on a quietly steady scale, and as producers there are carefully avoiding unduly depressing the market by overloading it with supplies, values have been maintained during the past week on a steadier basis. Tin, also, has experienced rather a better time, and no further ground has been lost, an important factor in this section of the market being that, for the time being at all events, the liquidation movement appears to have exhausted itself. The demand for lead and spelter continues on a relatively moderate scale. During the past week a rather firm tone has characterised the lead market, although at the moment there is a slightly easier feeling. In spelter values have receded a little, but the difference on balance is not very important.

Iron.

In the iron market the position in respect of pig has not altered. Very little Staffordshire or Lincolnshire iron is obtainable here, and stocks of Derbyshire makes are necessarily dwindling. Sellers are very firm, and there are indications of a further stiffening in values, Derbyshire No. 3 being quoted at 77s. 6d. per ton, delivered Manchester or equal, although up to 80s. per ton has been mentioned this week as the basis of business. Small quantities of Scottish No. 3 and East Coast hematite are available at about 91s. and 97s. 6d. per ton respectively, including delivery. Blast-furnaces are still out of commission and there is no likelihood of a resumption of operations until the coal dispute is definitely settled. In the case of manufactured iron there is only a quiet demand reported, and stocks are fairly good. Most of the forges are closed down altogether, although one or two in the Lancashire area manage to keep going on a restricted scale. Lancashire Crown bars continue to be offered here at the prices ruling before the stoppage, that is, £11 per ton delivered, with second quality bars quoted at £9 15s.

Steel.

There has been no change in the quotations of £7 2s. 6d. per ton, delivered Manchester or equal, for steel joists and sections, £7 17s. 6d. per ton for tank plates, and £8 to £8 5s. per ton for steel bars, but there is very little selling at these prices, and then only against contracts, makers showing no disposition whatever to enter into fresh commitments. The rolling mills are not working, and stocks are small, the result being that users are finding it extremely difficult, if not impossible, to pick up supplies. There has been a run on stocks in merchants' hands, and these have been offered in most cases at pre-strike prices. With the exception of one fairly good order, there has been little done in galvanised sheets for the Indian markets, some merchants still having small parcels on their hands.

Prices are steady, however, at from £15 10s. to £15 15s. per ton, f.o.b., for the usual Bombay specifications. Offers of continental steels are still weak at about £6 per ton for sections, £5 10s. to £5 12s. 6d. for joists, £6 2s. 6d. for ordinary plates, £6 10s. for Siemens' plates, £5 to £5 2s. 6d. for sheet bars, and £5 17s. 6d. per ton for steel bars, delivered in this area, for cash against documents.

Scrap.

Both iron and steel and non-ferrous metal scrap are slow. Textile machinery scrap averages about 70s. per ton, ordinary machinery cast iron scrap 62s. 6d., mild steel 52s. 6d., and wrought iron 62s. 6d. on truck Manchester. Cast aluminium scrap is now quoted at about £84 per ton; selected heavy yellow brass, £45; brass rod turnings, £39; clean light copper scrap, £57; braziery copper, £48; lead, £27 to £28; zinc, £24; and selected gun-metal scrap, £51, for graded materials, and including delivery to consumers' works.

BARROW-IN-FURNESS.

Marking Time.

There is no production of either iron and steel in this district, and such deliveries as are being made are from stock. There is a certain amount of iron being sent away by rail, but the tonnage is not great. Last week's cargoes of pig iron were dispatched from Barrow to Treport and Philadelphia. The American business continues, and when the blast-furnaces are working again there will be further dispatches of iron to the United States. The iron, generally speaking, is of a semi-special quality. The hoop and small section mills at Barrow are still working. At Vickers' works the general run of activity is proceeding, and the shortage of coal has had no effect up to the present owing to the stocks held in case of emergency. Both the gasworks and the electricity departments are supplying all requirements in the district, but the extensive Barrow paper mills have had to stop owing to shortage of fuel. A restart may be made by the installation of oil fuel burners for the boilers. In the docks several of the London, Midland and Scottish cross-Channel steamers are being overhauled for the summer services, as also are four steamers of the Isle of Man Steam Packet Company. Household fuel is practically non-existent.

SHEFFIELD.

(From our own Correspondent.)

Increasing Unemployment.

EACH week sees a curtailment of activity in local industries, owing to the exhausting of coal stocks, and thousands of workers are now suspended and are claiming unemployment pay. No open-hearth steel has been produced since the commencement of the coal stoppage, and in the Sheffield district between thirty and forty large-capacity furnaces are idle. A similar state of things prevails in the Lincolnshire iron and steel producing centres. Foundries are the most favourably placed, and they have been able to carry on with coke from stock, either in the locality or from further north. While the work of the heavy departments has been restricted there is plenty of evidence that orders which would have come to this district have gone to foreign competitors, and but for the existing trouble there is every reason to believe that the works would be busier than they have been for a long time. In fact, there is so much business waiting to be placed that many manufacturers believe that if the dispute is settled in a definite manner at an early date, there will be a sharp revival in the iron and steel trades in all their branches.

Lighter Local Trades.

Although engineering work is rather quiet, there is a fairly brisk demand for engineering tools. Fortunately, the supply of electricity and gas in Sheffield is being maintained on a gratifying level, though, of course, there have been restrictions. This has enabled plants which are not dependent upon raw fuel to continue work at a reduced level. Firms making lighter steel goods report having a fair amount of work in hand awaiting completion. The plate and cutlery works are feeling the effects of the dispute to a varying degree. Some are continuing with a restricted output, but a good many of them closed last week, either through lack of orders—business which was not strong to start with, having been badly hit by the labour troubles—or through lack of fuel. Cutlery exports last April were of a discouraging character, the monthly total being the worst for several years. Except for ordinary razors, the falling off was marked in all descriptions of cutlery. The total export trade during April was of the value of £64,113, compared with £93,290 in March and £81,338 in April of last year. The shipments to Australia, New Zealand and Canada recorded a considerable decline.

Engineering Departments.

There are practically no important developments to report in connection with engineering work, owing to so many plants being shut down. The Engineering Committee of Sheffield Corporation Tram Department, however, has proceeded with certain work which it has in hand, and has placed the following contracts:—1000 tons of steel rails, Steel, Peech and Tozer, at £10 12s. 6d. per ton; 1000 pairs of fish-plates, Cammell Laird and Co., at 16s. 6d. a cwt.; 250 pairs of fish-plates from the same firm, at 12s. 6d. a cwt.; 1000 sole plates from the same firm at 12s. a cwt.; and 19 tons of mild steel bars, from Hadfields, at 15s. 6d. a cwt. The works of the Park Gate Iron and Steel Company were fairly well employed throughout the past year, and a profit of £51,026 was made. This sum will be applied to reduce the debit balance of £117,321 brought in. The report records that there was no improvement in the steel trade during the past year. On the contrary, competition was more intense than ever, owing to the excess productive capacity of the country in comparison with the demand for steel, and prices fell considerably in consequence.

Coal and Colliery Topics.

Sheffield people have come out fairly well so far under the coal rationing system, and Mr. G. C. Brooks, the Coal Emergency Officer, has been able to meet all urgent calls for domestic fuel. So large, however, was the number of applications for permits for allowances that registration had to be suspended early this week, largely owing to the problem of distribution. The industrial position is gradually getting worse, but limited quantities of fuel are being sent to the works to keep them going wherever this step is possible. There are many coal outcrops in the Sheffield district, and, as on the occasion of other coal stoppages, they are being worked on an extensive scale. There is one colliery still operating in the city boundary. This, which is at Gleadless Common and works good Silkstone coal, is owned and worked solely by the members of one family—a father and three sons. Two years ago Sheffield Corporation installed a plant for making briquettes from the fuel contents of the city's refuse. These briquettes have been rather a drug on the market, and last year the Corporation had so many on its hands that it exported 500 tons to Portugal. The daily output of 50 tons is now being promptly disposed of, the price being 10d. a cwt., or 15s. a ton delivered. It is stated that Sheffield Corporation is the only municipality that deals with its refuse in this way. The Bolsover Colliery Company is to make an issue of debentures in order to provide the necessary funds for the completion of Thoreaby Colliery and other developments. The Mines Department sent an intimation to a meeting at Doncaster of local landowners and of the Committee of the Mineral Owners' Association, that the mineral owners are to be conceded a representative on the Royal Commission about to be established in connection with subsidence in the Doncaster area. Earl Fitzwilliam, who is President of the Association, has been invited to be the representative on the Commission.

Thorne Colliery Development.

An optimistic view of the future of Thorne Colliery, near Doncaster, was taken by Lord Gainford, speaking at the annual meeting of Pease and Partners. During the year the company, he said, had spent £190,209 on Thorne Colliery, making the total £1,062,280. It was now able to draw 300 tons a day, and expected during the autumn to reach 1000 tons. Thereafter the output would progressively increase to its maximum. In laying out Thorne, they had studied American methods, and they did not want to be behind anyone in securing the best possible results. The directors believe that the policy will prove advantageous of substituting colliery operations in thick seams of good quality in the South Yorkshire area for the thin seams of soft coal in the South Durham coalfield, which are becoming gradually exhausted.

Death of a Well-known Draughtsman.

The death took place at Halifax on May 22nd of Mr. Richard Henry Hayhurst, who for more than twenty years occupied the position of chief draughtsman of the Butler Machine Tool Company, Ltd. He was a man widely known and highly respected, possessing wide general knowledge and exceptional technique in machine tool design. Mr. Hayhurst was born in Wyresdale, near Lancaster, sixty-eight years ago. His connection with the Butler firm dated back twenty-seven years.

NORTH OF ENGLAND.

(From our own Correspondent.)

Miners and the Crisis.

The policy of drift in the coal crisis appears to be causing increased restlessness among the miners of of Durham and Northumberland, and stirring them to demand that something shall be done to end the deadlock, which is not only striking a disastrous blow at their own vocation, but is gradually paralysing other industries. There is undoubtedly in the Northern coalfields a genuine desire to prevent the stoppage continuing to deeper disaster. Many of the pits in Durham are old, and it is feared that if the present stoppage is prolonged, some of them may be permanently dismantled. This is happening now at the Newton Cap pit at Bishop Auckland. It has been laid up eighteen months as an uneconomic proposition. Always it has been hoped that the pit would be reopened, but the pumps are being dismantled, and it is evidently intended to abandon it. In the Durham coalfield interest centres in the mass meetings which are being held in the county this week. They have been convened on behalf of the four committees of the Durham County Mining Federation Board, which embraces all mine-workers—miners, cokemen, mechanics, and enginemen. The purpose of the meetings is indicated in a brief circular issued to the lodges—to get in touch with the county. This desire is no doubt reciprocated by the miners, many of whom consider that they ought to have been consulted earlier.

Important Move in Northumberland.

The outcry against the absence of a move for peace is especially keen in Northumberland, where the first advance in the way of consulting the rank and file will be made. This is the outcome of a decision reached at a special meeting of the Council of the Miners' Association, which was called to hear the reports of the delegates who had attended the recent miners' national conference in London. The Executive Committee and Wages Board of the Association submitted the following proposal to the Council:—"That this Council meeting of the Northumberland Miners' Association recommend to the Executive Committee of the Miners' Federation of Great Britain the opening out of negotiations with the coalowners and the Government with a view to securing the best terms possible of a national settlement on the lines of the Coal Commission's report, such terms to be laid before a national conference for decision, and afterwards submitted to a ballot vote of the members of the Federation for acceptance or otherwise." On a vote being taken on the proposal, thirty-three delegates voted for it, and thirty-six against. The motion, however, is not done with. It must now be submitted to the lodges for final voting. Having regard to the closeness of the result and to the favour stated to have been shown by the representatives of the bigger branches, it will not be surprising if the Council's decision is reversed.

Export Trade Strangled.

The disastrous effect of the Labour upheaval is reflected in the exports of iron and steel from the Cleveland district during May. The trade has been almost strangled by the strikes. First came the general strike, which left employers no alternative but to close down, even though they had reserves of fuel which might have permitted them to carry on industrial operations for a time. Then, when the general strike was called off, the Tees dockers were amongst the recalcitrants, with the result that there was a continued hold up of the shipping trade, and finally, when the dockers became more amenable, the tugboatmen stopped work and they still, in fact, remain on strike. Under such circumstances it is not surprising that the month's exports of iron and steel have shrunk to about one-third of the normal. In March the aggregate tonnage of iron and steel shipped from the Cleveland district was 113,213, in April it fell to 89,036, and in May to 33,429. Better shipping facilities may permit of more material being delivered this month, but the works being closed down, deliveries can only be made from stock, and the resumption of normal trading is consequently entirely dependent upon the termination of the coal strike. Foreign trade has almost vanished for the time being, only 2450 tons of pig iron, and 26,088 tons of manufactured iron and steel being shipped abroad during the month, the corresponding figures for April being 13,534 tons and 50,955 tons respectively.

Cleveland Iron Market.

The general situation in the Cleveland pig iron market shows little change. With every prospect of increased cost of production as a result of dearer fuel, values of pig iron show a marked upward tendency. Business has shrunk to small proportions, and expansion of transactions to any extent cannot be looked for until regular and ample deliveries of fuel are obtainable. An undertone of hopefulness is, however, still noticeable, and the opinion continues to prevail that a fair amount of activity will be experienced with the re-opening of the collieries. Meanwhile, the uncertain feeling as to the level at which prices are likely to settle is altogether holding up business. Under such circumstances it is not at all surprising to find both buyers and sellers pursuing a most cautious policy. The stocks at some of the Cleveland works are stated to be fully sold, and it is understood that merchants have little iron available for disposal. Thus, with output all but stopped, the only furnaces running on Cleveland pig iron being two at the works of Bolckow, Vaughan and Co., Ltd., a great shortage of iron is threatened. Nominally prices are unchanged, No. 1 foundry iron being 76s. per ton; No. 3 G.M.B., 72s. 6d.; No. 4 foundry, 71s. 6d.; and No. 4 forge, 71s., all f.o.t. In the case of iron for export 6d. per ton more is asked.

Hematite Pig Iron.

East Coast hematite is distinctly firmer. Two furnaces are working at Consett, but they are, of course, not sufficient to meet the demand, and with stocks falling, the makers are inclined to stiffen prices. This week mixed numbers are quoted at 77s. 6d., and No. 1 at 78s. per ton, these prices representing an advance of sixpence.

Manufactured Iron and Steel.

In the manufactured iron and steel trade prices are nominally unchanged, but makers do not care to do business, and in some cases ask more than the recent minimum. The Ayrton Sheet Mills of Dorman, Long and Co., Ltd., were restarted this week after being idle since the general strike.

The Coal Trade.

Business is still at a standstill on the Northern coal markets. Owners and shippers generally are still hoping that this week will see a settlement, but the most optimistic regard the end of June as being the earliest date for any resumption of export output. Accordingly no effort is being made to negotiate any forward business, while all foreign customers are regarding a settlement as so indefinite that they are freely covering their next quarter's requirements from foreign producers, and the outlook to secure trade for July to September for this area is daily becoming more serious. The general view is that no matter when a settlement is reached it will take some months to win back a moderate share of the ordinary export trade.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding.

THE difficulty in obtaining fuel and other materials is amply demonstrated by the launching returns for the month of May. From Clyde yards sixteen vessels of 19,744 tons aggregate were launched, bringing the total for this year to date to sixty-eight vessels of 140,031 tons aggregate, compared with ninety-two vessels of 259,506 tons aggregate in the same period last year. The figures for five months therefore show a tonnage decrease of nearly 50 per cent. Of the vessels launched, only three were of 5000 tons measurement or over:—Zvir, cargo steamer, 5900 tons, built for Susak owners; Storsten, single-scew motor ship, 5150 tons, for the Wonsberg Rederi, Tonsberg, Norway; Counsellor, cargo steamer, 5000 tons, for T. and J. Harrison, Liverpool.

London Coal Carrier.

There has just been launched by the Burntisland Shipbuilding Company the specially designed coal-carrying

steamer Ewell. This vessel, which has been built for the Wandsworth, Wimbledon and Epsom and District Gas Company, London, is of 1360 tons gross tonnage and 2050 tons deadweight, and has collapsible funnel, mast and upper deck structures, so that she may pass under the Thames bridges. Special water ballast capacity and two large hatches are also provided for. Engines designed to give a speed of 10 knots will be supplied by the North-Eastern Marine Engineering Company, Wallsend-on-Tyne.

Closure of a Port-Glasgow Shipyard.

The shipyard and engineering shops of Dunlop, Bremner and Co., Ltd., Port-Glasgow, have been closed down. The announcement states that no more vessels will be built by the firm, and that the company is in liquidation. For many years this firm held a high reputation for the building of oil tank steamers, cable steamers, fruit carriers, light draught vessels, high-class passenger steamers of medium size, and steam yachts. For the past six years or so this company has formed part of a large group of shipbuilding, engineering, coal and ironworks, controlled by Lithgows, Ltd., shipbuilders, of Port-Glasgow.

Iron and Steel.

The iron and steel markets are practically at a standstill. In one or two instances where supplies of fuel are ample for some weeks works have been put into operation, but prospects in respect to new business are more or less negligible. The bulk of the steel works are inoperative. The accumulation of orders reported by bar iron makers may provide work for a few weeks or as long as fuel supplies last. Few pig iron furnaces are in operation. Steel sheet makers are comparatively busy.

Coal.

There has been no change of importance in the coal situation since last week. Bunker coal at Glasgow harbour is extremely scarce, and many foreign-going cargo steamers and regular coasters are held up. House coal is scarce, and even the ration allowance of 1 cwt. per fortnight is difficult to secure. Unscreened fuel retails at 2s. 7d. per cwt., and coal screened by merchants from 3s. to 3s. 3d. per cwt. Considerable distress exists in all colliery districts, relief funds having practically dried up.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

As the period stipulated by the Government for the acceptance of its conditional offer of a subsidy of £3,000,000 has expired, there is a good deal of speculation as to what action will follow on the part of the Government; but whatever step is taken, the belief is held that there can be no work in the coalfield before the middle of June, while in some quarters no resumption is looked for until July. One or two small colliery undertakings which are not associated with the South Wales coalowners' organisation have made approaches to the workmen that work should be resumed on the conditions in operation prior to the stoppage, but so far the men have declined to entertain the idea until there is a general resumption of work in the coalfield. The conditions prevailing in the coalfield are extremely quiet and orderly, though there is undoubtedly a good deal of distress. At the end of last week the Executive Council of the South Wales Miners' Federation devoted considerable time to the question of relief, and it was agreed that all the funds available should be utilised for the purchase of food, and should not be distributed in cash payments. Although not stated officially, it is reported that the South Wales Federation is setting apart the sum of £20,000 from its funds to be allocated to the various districts in this area for the relief of the miners.

Coal Supplies and Competition.

A few steamers with cargoes aboard, which have been detained since the stoppage of work in the coalfield, have been allowed to sail from this district to their original destinations. This has created some surprise in view of the shortage of coals. One steamer allowed to go from Port Talbot was the ss. Linaria, which had a cargo of about 4700 tons of anthracite and steam coals. This steamer is now on her way to America, and yet considerable quantities of American coals are being imported to this country. A cargo of Crown patent fuel of about 4000 tons has also been released, after being held up for a month, this cargo being for Rio de Janeiro. So far as can be ascertained, purchases of American gas and steam coals run to about 200,000 tons, and some of the cargoes will be arriving in this country about the end of this week and early next. It is understood that the bulk of these coals are intended for gasworks and railway undertakings. The amount of business which has been done altogether in American and German coals is causing some concern to exporters here, as, assuming an early resumption of work is brought about in this country, it is feared that the commitments of foreign consumers will not permit them to place orders for Welsh coals on any great scale, so that the export trade from this district would be very quiet for some time. Stocks at foreign coaling stations have become practically exhausted, and prices have advanced recently anything from 5s. to 11s. per ton, and the owners of the foreign depôts have been compelled to replenish their stocks with German coals to a very large extent. The Portuguese State Railways, which almost invariably come to South Wales for their supplies, have purchased about 10,000 tons of German coals and 5000 tons of American coals, while it is reported that an order for 35,000 tons of steam coals for South America has been lost to this country on account of the suspension of production. As an instance of what the Americans can do, it may be mentioned that the Cardiff-owned steamer Monkton, which was lying in Hampton Roads, was chartered on Thursday afternoon of last week to load a cargo of American coals for this country. She at once proceeded to the piers at Norfolk, and within twenty-four hours was loaded with 5200 tons of cargo and bunkers.

Home Stocks.

There are fairly good stocks of patent fuel and dry coals in this district, but the qualities suitable for household use and for industrial purposes are rather scarce. Trawler owners at Milford Haven went to the expense of securing two cargoes of Scottish coals for the bunkering of their vessels, but the authorities stepped in and are reserving the coal for home requirements. Patent fuel has been released for bunkers for trawlers at Cardiff and Swansea. Three steamers belonging to one firm which had been laid up at Cardiff had sufficient bunkers on board to take them to Brixham, where the owners intended taking in fresh supplies of French coal, so as to enable the steamers to get away to load cargoes of American or German coals. Local authorities in Monmouthshire and South Wales received at the end of last week a communication from the secretary of the Coal Emergency Committee informing them that, as from Tuesday of this week, only patent fuel and ovoids would be supplied to the merchants for distribution amongst the public for domestic purposes. The quantity for each householder is limited to 1 cwt. per week. The present stocks of coal available for household purposes are being rigidly reserved for cases of sickness, food requirements and essential purposes.

Steel and Tin-plate Works.

Owing to lack of fuel, Baldwins, Ltd., decided to close its steel works, except the bar rolling mills, as from Saturday last. Twelve mills at the Pontnewynydd Sheet and Galvanising Works were to be restarted on Monday, thus giving employment to between 700 and 800 men. The Taibach Tin-plate Works at Port Talbot, employing 150 men, were to be restarted this week, but the majority of tin-plate works are badly affected by the shortage of coal. At Messrs. Lysaghts' works, at Newport, the men are only working three days a week.

Steel Workers' Wages.

On Friday of this week the Joint South Wales Siemens Steel Board will consider the question of continuing the bonuses to workmen. The last ascertainment of the selling price of Siemens steel sheet and tin bars for the three months ending March 31st, which governs the wages of the steel workers, worked out at an average price of £6 0s. 4½d. per ton, which is equivalent to 10 per cent. under the sliding scale, but the wages of the men were unaffected up to May 29th last, owing to the bonus granted by the employers. The steel workers at Gorseinon have passed a resolution against accepting any reduction of wages below 45s. per week. It is stated that if the bonus is terminated the lower-paid workmen will be reduced to 33s. per week.

Latest News from the Provinces.

WALES AND ADJOINING COUNTIES.

Tin-plate Prices.

Owing to the restricted production of tin-plates and the diminution of stocks the demand has improved, and prices during the past week have advanced 1s. per standard box to 20s. 3d.—20s. 6d.

Fuel Works to Restart.

The majority of works have been at a standstill owing to the shortage of coals, but as the authorities have decided to release small coals, some of the works will be able to resume production of patent fuel, the price of which for domestic use is 25s. per ton, but for industrial and other purposes 32s. 6d. per ton f.o.t.

Cargoes of Scotch Coals.

The two cargoes of Scotch coals brought to Milford Haven for the bunkering of fishing trawlers are now to be discharged, the authorities having given the necessary permission.

LAUNCHES AND TRIAL TRIPS.

BELJEANNE, twin-screw motor ship; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., to the order of Rederiet Belpareil A/S., of Oslo; dimensions, 427ft. 6in. by 68ft. by 33ft. 6in.; 10,375 tons deadweight. Engines, twin-screw Armstrong-Sulzer, two-cycle type Diesel, 600 mm. diameter by 1060 mm. stroke; constructed by the builders; launch, April 15th.

SAN NICOLAS, oil vessel; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co., for the Lago Shipping Company, Ltd.; dimensions, 315ft. by 50ft.; 2360 gross tonnage. Engines, twin-screw, triple-expansion, pressure 180 lb.; constructed by the builders; launch, April 15th.

SPEYBANK, motor vessel; built by Harland and Wolff, Ltd., to the order of Andrew Weir and Co. (Bank Line, Ltd.); dimensions, 434ft. by 53ft. 9in. by 37ft; 5200 gross tonnage. Engines, two sets of Harland-B. and W. six-cylinder 4-cycle motors; constructed by the builders; trial trip, April 20th.

BELRAY, single-screw motor ship; built by Sir W. G. Armstrong, Whitworth and Co., Ltd., at their Walker Shipyard; to the order of the Rederiet Belnor A/S of Oslo; dimensions, 328ft. 9in. overall length, 46ft. moulded breadth; to carry 4235 tons deadweight on a mean draught of 19ft. 8in. Engines, inverted, four-cylinder, direct-acting reversible, single-acting two-cycle Armstrong-Sulzer, designed to develop 1350 brake horse-power at 110 revolutions per minute; constructed by the Marine Department of the builders; satisfactory full speed trial trip at sea, May 3rd.

AFRICSTAR, steamer; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the Blue Star Line (1920), Ltd.; dimensions, 494ft. long; 11,750 tons deadweight. Engines, twin-screw single reduction geared turbines; constructed by the builders; launch, May 11th.

BRITISH INVENTOR, oil tanker; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the British Tanker Company, Ltd.; dimensions, 447ft. by 57ft. 8in. beam; 10,650 tons deadweight. Engines, single-screw triple-expansion; constructed by the builders; launch, May 11th.

BAYBURT, passenger and cargo vessel; built by the Ardrossan Dockyard, Ltd., to the order of the Hudson's Bay Company; dimensions, 335ft. by 51ft. by 31ft. 3in.; 3700 tons deadweight. Engines, triple-expansion, 23½in., 37½in., and 63in. diameter by 39in. stroke, pressure 200 lb.; constructed by J. G. Kincaid and Co., Ltd.; trial trip, May 12th.

STORSTEN, single-screw motor ship; built by Barclay, Curle and Co., Ltd., at their West Shipbuilding Yard, Scotstoun; to the order of the Tönsberg Rederi A/S, of Norway; dimensions, 388ft. long, 52ft. 6in. moulded breadth, 29ft. 3in. moulded depth; to carry 7700 tons deadweight, gross tonnage 5150. Engines, one set of the builder's patented two-stroke double-acting Diesel engines are being constructed at the North British Engine Works, Whiteinch; estimated speed, 11 knots; launch, May 12th.

NORTHLAND, passenger steamer; built by Swan, Hunter and Wigham Richardson, Ltd., to the order of the Clarke Steamship Company, of Canada; dimensions, 300ft. by 47ft. beam. Engines triple-expansion; constructed by the builders; trial trip, May 14th.

GEORGE LIVESEY, steam tug; built by Harland and Wolff, Ltd., to the order of the South Metropolitan Gas Company; dimensions, 63ft. by 21ft. by 10ft. 6in. Engines, compound, surface-condensing type, 18in. and 38in. diameter by 27in. stroke; constructed by the builders; launch, May 20th.

PAPUDO, tug and water carrier; built by Harland and Wolff, Ltd., to the order of the Pacific Steam Navigation Company; dimensions, 62ft. by 15ft. 2in. by 7ft. Engines, compound, surface-condensing type, 9in. and 16in. diameter by 12in. stroke; trial trip, May 29th.

SAN NICOLAS, shallow-draught oil vessel; built by Harland and Wolff, Ltd., to the order of the Lago Shipping Company, Ltd.; dimensions, 315ft. by 50ft.; 2360 gross tonnage. Engines, twin-screw, triple-expansion, pressure 180 lb.; constructed by the builders; trial trip, May 20th.

TOAS, oil tank steamer; built by Palmer's Shipbuilding and Iron Company, Ltd., to the order of the Venezuela Gulf Oil Company, of Caracas; constructed on the Isherwood system of longitudinal framing; trial trip, May 21st.

SPRINGBANK, twin-screw motor vessel; built by Harland and Wolff, Ltd.; to the order of Andrew Weir and Co. (Bank Line, Ltd.); dimensions, 434ft. by 53ft. 9in. by 37ft.; 5200 gross tonnage. Engines, two sets of Harland-B. and W. six-cylinder four-cycle motors; constructed by the builders; trial trip, May 26th.

BRYNJE, motor ship; built by Burmeister and Wain, Ltd., to the order of A/S. Borgestad, Borgestad at Porsgrund, Norway; dimensions, 350ft. by 51ft. 3in. by 27ft. 3in.; 3924 gross tonnage. Engines, six-cylinder, four-stroke cycle, single-acting and forced lubricated Diesel; constructed by the builders; trial trip, April 27th.

CATALOGUES.

GEORGE ANDERSON, 9, Fenchurch-avenue, E.C. 3.—List of dredgers and floating plant for sale.

PETER BROTHERHOOD, Ltd., Peterborough.—Booklet dealing with steam turbines and illustrating a few typical installations.

THE D.P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Booklet entitled "Electric Locomotives for Military Purposes."

THE MIRRLEES WATSON COMPANY, Ltd., Scotland-street, Glasgow.—A number of sugar machinery pamphlets printed in Spanish.

THE MORTON MACHINE COMPANY, Wishaw, Scotland.—Catalogue of bakers', confectioners', and preserve makers' machinery and plant.

THE PARSONS MOTOR COMPANY, Ltd., Town Quay Works, Southampton.—Publication No. 80, entitled "Parsons Marine Installations."

CROFTS (ENGINEERS), Ltd., Thornbury, Bradford.—Brochure on flexible couplings showing a variety of designs suitable for general industrial requirements.

WILLIAM BEARDMORE AND CO., Ltd., 3, Manchester-street, London, W. 1.—Pamphlet on Beardmore-Caprotti valve gear as applied to marine steam engines.

THE UNIVERSAL SYSTEM OF MACHINE MOULDING AND MACHINERY COMPANY, Ltd., 97, Queen Victoria-street, E.C. 4.—Leaflet describing the "Exo" pulley block.

JOHN LANG AND SONS, Ltd., Johnstone, near Glasgow.—Catalogue illustrating and describing in detail new designs of "Lang" lathes of all types and sizes.

ATELIERS DES CHARMILLES (S.A.), Geneva, Switzerland.—Booklet describing various hydraulic turbine installations by the company in power stations.

ED. DEANE AND BEAL, Ltd., 3, Monument-street, E.C. 3.—Brochure describing the "Consumate" evaporative condensing system and illustrating various installations.

"NORTON AND GREGORY ENGINEERING SCHOLARSHIPS, 1926."—We are informed by Norton and Gregory, Ltd., of Castle-lane, Buckingham Gate, London, S.W. 1, that the following scholarships, total value £450, have now been awarded:—(a) Arthur John Moakes, St. Paul's School, West Kensington, London, £100 per annum tenable for three years at Cambridge University; and (b) Francis Luke Lambert, Westminster City School, London, £50 per annum tenable for three years at London University.

IRON TRADES EMPLOYERS' INSURANCE ASSOCIATION, LTD.—The Report of the Iron Trades Employers' Insurance Association, Ltd., which was presented at the annual general meeting of members held on Thursday, May 6th last, showed that, as the result of the year's working, the premium income of the Association had amounted to £543,447, which with £74,187 dividends and interest on invested funds, £11,267 profit on realised investments and £43,650, the balance brought from 1924 account, made the total receipts £672,552. The amount paid and set aside in respect of compensation and incidental expenses during the same period amounted to £468,855, and after providing £64,808 for expenses of management, directors' fees, auditors' fees, hospital donations, corporation profits tax, &c., there remained a balance on revenue account of £138,889. The directors recommended that a return at the rate of 20 per cent. of the Workmen's Compensation Premium paid for 1925 be made to the present policy holders of the Association entitled thereto. The directors who retired by rotation, and were eligible, offer themselves for re-election, were Mr. John Barr, Mr. W. Jackson, Mr. Tom Westgarth, and Sir John Hunter K.B.E. The Report went on to state that Sir John Dewrance, K.B.E., had resigned from the Board on the ground of ill-health, that in his place the directors had elected Sir John E. Thornycroft, K.B.E., managing director of John I. Thornycroft and Co., Ltd., and that it was proposed, in addition, to recommend to the members the election of Mr. F. J. West, of West's Gas Improvement Company, Ltd.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	18/- to 21/-
(1) Spanish	18/- to 21/-
(1) N. African	18/- to 21/-
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 0	—
No. 1 Foundry	3 19 0 to 4 1 6	
No. 3 Foundry	3 16 6 to 3 19 0	
N.E. COAST—		
Hematite Mixed Nos.	3 17 6	3 17 6
No. 1	3 18 0	3 18 0
Cleveland—		
No. 1	3 16 0	3 16 6
Silicious Iron	3 16 0	3 16 6
No. 3 G.M.B.	3 12 6	3 12 6
No. 4 Foundry	3 11 6	3 12 0
No. 4 Forge	3 10 6	3 11 0
Mottled	3 10 0	3 10 6
White	3 10 0	3 10 6
MIDLANDS—		
(5) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 7 6	
,, Forge	2 16 0	—
(3) Derbyshire—		
No. 3 Foundry	3 7 6 to 3 10 0	
Forge	3 2 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 7 6 (a); 4 10 0 (b); 4 15 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 0 0	—
Second Quality Bars	9 15 0	—
Hoops	14 0 0	—
S. YORKS.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 0 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 5 0 to 12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 12 6	7 0 0
Sections	7 2 6	6 5 0
Steel Sheets, under 3/16in. to ½in.	8 15 0 to 9 5 0	
Sheets (Gal. Cor. 24 B.G.)	— £15 7 6 to £16 10s.	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 12 6	—
Angles	7 2 6	—
Boiler Plates	11 10 0	—
Joists	7 2 6	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
MANCHESTER—		
Bars (Round)	8 0 0 to 8 5 0	
,, (others)	8 0 0 to 8 5 0	
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	7 17 6	—
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	6 15 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 15 0 to 8 2 6	
Billets and Sheet Bars	6 2 6 to 6 5 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	15 10 0 to 15 15 0	
Angles	7 2 6 to 7 7 6	
Joists	7 2 6 to 7 7 6	
Tees	8 2 6 to 8 7 6	
Bridge and Tank Plates	7 17 6 to 8 2 6	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	20/3 to 20/6
Block Tin (cash)	266 0 0
,, (three months)	264 10 0
Copper (cash)	56 5 0
,, (three months)	57 2 6
Spanish Lead (cash)	29 3 9
,, (three months)	29 10 0
Spelter (cash)	32 3 9
,, (three months)	32 13 9
MANCHESTER—	
Copper, Best Selected Ingots	61 15 0
,, Electrolytic	65 5 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 0½
Brass Tubes (Basis Price)	0 0 11½
,, Condenser	0 1 2
Lead, English	31 5 0
,, Foreign	30 2 6
Spelter	33 5 0

FERRO ALLOYS.

(All prices now nominal.)

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/- per lb.	
Ferro Tungsten	1/9d. per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£38 10 0	12/6
,, ,, 1 p.c. ,,	£44 10 0	15/-
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5½d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£20 10 0 scale 6/- per unit	
,, Vanadium	14/6 per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/- per lb.	
Aluminium (per ton)	£112	

FUELS.

SCOTLAND. (*Prices nominal.*)

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	15/9
,, ,, Ell	16/6
,, ,, Splint	16/6 to 17/-
,, ,, Trebles	15/9
,, ,, Doubles	14/- to 14/6
,, ,, Singles	13/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	16/9
,, ,, Jewel	17/- to 17/6
,, ,, Trebles	17/-
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/9
Screened Navigation	21/-
Trebles	14/- to 15/-
Doubles	14/-
Singles	13/- to 13/6
LOTHIANS	
(f.o.b. Leith)—Best Steam	14/- to 14/3
Secondary Steam	13/6
Trebles	14/6 to 14/9
Doubles	13/6
Singles	13/6

ENGLAND.

(8) N.W. COAST—	
Steams	23/-
Household	40/- to 48/-
Coke	24/-
NORTHUMBERLAND—	
Best Steams	16/-
Second Steams	14/6 to 15/-
Steam Smalls	8/- to 8/6
Unscreened	13/- to 13/6
Household	20/- to 22/-
DURHAM—	
Best Gas	18/6 to 19/-
Second	15/- to 15/6
Household	20/- to 22/-
Foundry Coke	18/- to 20/-

SHEFFIELD	Inland.	
Best Hand-picked Branch	31/- to 34/-	—
Barnsley Best Silkstone	28/- to 30/-	—
Derbyshire Best Brights	26/- to 28/-	—
,, ,, House	24/- to 25/-	—
,, ,, Large Nuts	17/- to 20/-	—
,, ,, Small	12/6 to 14/-	—
Yorkshire Hards	17/- to 19/6	—
Derbyshire Hards	16/- to 19/-	—
Rough Slacks	10/- to 12/6	—
Nutty Slacks	7/6 to 9/-	—
Smalls	3/6 to 6/-	—
Blast-furnace Coke (Inland)*	—	—
,, ,, (Export)	f.o.b.	16/- to 17/-

(9) SOUTH WALES. (*All prices nominal.*)

CARDIFF—	
Steam Coals:	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/- to 25/-
Ordinary Dry Large	21/- to 22/-
Best Black Vein Large	25/6 to 26/-
Western Valley Large	24/6 to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary ,, ,,	23/6 to 24/-
Best Steam Smalls	17/- to 18/-
Ordinary ,,	16/- to 17/-
Washed Nuts	19/- to 26/-
No. 3 Rhondda Large	26/6 to 27/-
,, ,, Smalls	18/- to 18/6
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 21/-
,, ,, Smalls	15/- to 16/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	22/- to 24/-
Pitwood (ex ship)	17/6 to 20/-
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	39/- to 40/-
Seconds	32/6 to 35/-
Red Vein	27/- to 29/-
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	42/6 to 44/-
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/-
Smalls	11/- to 15/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Export Trade.

THE depreciation of the franc has had the effect of restricting home business and of giving a temporary stimulus to the export trade. Home industrial activity depends upon confidence, the want of which is largely responsible for the currency decline, and if only money could be induced to go into industrial undertakings, the country would enter upon another period of prosperity. There is ample work if only capital can be provided to put it in hand. For some time the steadily declining home business found compensation in a largely growing export trade, but the franc having touched a level which seemed to offer a very precarious chance of recovery, there was nothing more to be done in the way of price cutting in foreign markets. When so much raw material has to be imported the price at which it must be purchased narrows down the margin between home and foreign selling costs. The recent heavy fall of the franc revealed to French makers the seriousness of their situation. They withdrew quotations and refused, in most cases, to accept new orders, and now they are fearful lest a too sudden appreciation, following upon the financial reorganisation which the Government declares will soon give promising results, will put up manufacturing costs so far above the international level as to cause a serious industrial crisis in the country. This is one of the problems which is making the financial reorganisation so extremely difficult. Meanwhile there is a heavy contraction in the foreign trade, from which it may be concluded that French makers are no longer able to quote low prices for export.

Wages and Production.

All around Paris there is a vast industrial population which is more or less undermined by foreign influences, and the repeated agitations and strikes are causing a great deal of trouble to manufacturers. A strike for higher wages at the Renault works compelled the firm to issue an appeal to the men to look at the situation in a more logical light if they would not bring ruin upon the flourishing motor car industry and deprive themselves of employment. The firm pointed out that nothing could be done to prevent the importation into France of huge quantities of American cars, which were being sent here despite heavy duties, because the American production was in proportion to the high wages paid. The company declares itself quite willing to pay a higher scale of wages if the production is increased, but it refuses to make any advance so long as the men persist in the attitude they adopted recently, when they endeavoured to force the hands of the firm by turning out as little as possible. For that reason the company was obliged to close down the works. The appeal was successful, for all the men returned last week. On the same day there was a huge fire which destroyed the pneumatic tire department and the stores of engines and parts, involving a loss of several million francs.

Hydro-electric Plants.

While it is hoped to carry through a good many of the hydro-electric installations with the aid of material supplied by Germany under the Dawes agreement, it is clear that some great financial effort must be made if the entire scheme is to be completed. Very little progress has been made with these undertakings during the past year on account of the difficulty of procuring capital, which has been showing a preference for electrical generating stations with steam equipments. Such stations are being laid down all over the country, much to the regret, apparently, of the Minister of Public Works, who declares that they will continue to necessitate an importation of coal, which it was the intention of the national electrification scheme to avoid. He therefore proposes to introduce a Bill into Parliament to impose a tax of 5 per cent. on the consumption of electricity, the product of which will be devoted to the carrying out of the hydro-electric scheme. It is estimated that the tax will produce about 100 million francs a year. The Minister argues that, as the country generally would benefit from the carrying out of schemes that would dispense with the necessity of paying huge sums every year for foreign coal, the country should contribute to the cost of laying down the hydro-electric plants, but that does not explain why the burden should fall solely upon consumers of electricity.

The Chambon Barrage.

On the Upper Romanche, in the Dauphiné, there is a large number of factories supplied with energy by hydro-electric plants which necessarily have an irregular delivery when depending upon a glacial source. The owners of the factories have therefore constituted a company, with the participation of the State, for the construction of a barrage across the gorge of the Romanche at Chambon. The barrage will have a height of 87 m. and its length will be 282 m., while the thickness at the base will be 33 m. It will create a lake of about 300 acres with a capacity of 54 million cubic metres. The volume of masonry employed will be 200,000 cubic metres. Preliminary works will consist in diverting the course of the Romanche through a tunnel, with a section of 23 square metres, and of the national road between Paris and Besançon, which passes through the valley. The barrage will not only serve to regulate the head of water at existing turbines but will provide an additional source of energy.

Brest-Casablanca Cable.

The French Post Office Department has increased considerably the message capacity of the submarine cable between Brest and Casablanca, by adapting the Picard apparatus, which has long been employed on the Mediterranean cable. The apparatus has merely been duplicated for the longer range. The installation has necessitated no special arrangement.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

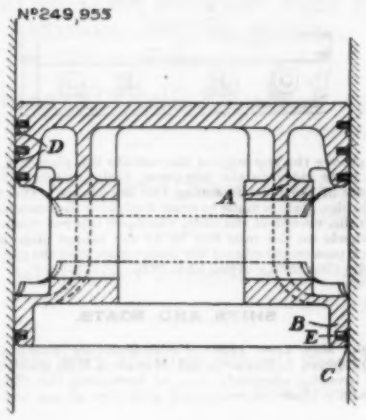
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

INTERNAL COMBUSTION ENGINES.

249,955. January 19th, 1925.—IMPROVEMENTS IN LUBRICATION MEANS FOR INTERNAL COMBUSTION PISTONS, Frederick Henry Royce, of Nightingale-road, Derby.

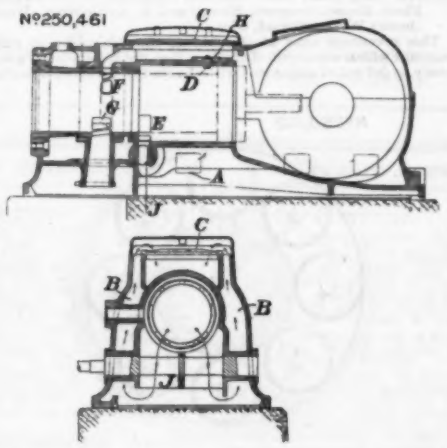
The inventor's object is to prevent an undue amount of oil passing the pistons of engines, particularly high-speed internal



combustion engines. As shown in the drawing, the piston is formed with a cylindrical boss A, which takes the gudgeon pin and supports the lower part of the piston skirt B. Clearance is provided at C below the ordinary piston rings, and recesses at D. E is a ring with a large and small internal diameter with the thin part placed uppermost, as shown.—*April 8th*, 1926.

250,461. September 7th, 1925.—TWO-STROKE OIL ENGINES, Babcock and Wilcox, Ltd., Babcock House, Farringdon-street, London, E.C. 4, A. Hall-Brown, G. C. Douglas and F. B. Chadwick.

This engine is, to a certain extent, cooled by means of an air jacket, and for this purpose openings A are formed in the bed to admit the passage of air to the jacket space B; a non-return valve C controls the passage between the jacket space and the interior of the crank case. In the cylinder wall are formed four sets of ports as at D, E, F and G. The outermost set of ports D is controlled by an automatic non-return valve H. A second set of ports E, controlled by a valve J, is placed at the junction of the cylinder portions of unequal diameters. The third set of ports F and the fourth set of ports G afford respectively an inlet to and an outlet from the inner end of the cylinder to permit the passage of a blast of scavenging air through the cylinder to carry

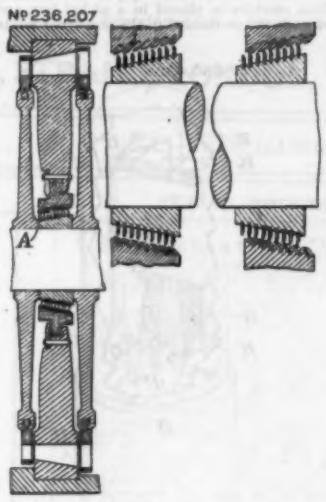


the exhaust products through the ports G. For the purpose of starting, the valve J is closed, and high pressure air is introduced to the annular space between the piston and the cylinder. Towards the end of the outward stroke the ports D are uncovered and the high pressure air released to the crank case by way of the non-return valve H. When the engine has started, the valve J is opened so that air is alternately drawn into and expelled from the annular space between the piston and the cylinder, the expelled air passing by way of the jacket space B and the non-return valve C to the crank case into which it is drawn, along with air passing through the ports A, on the inward or return stroke. During the outward, or working, stroke of the piston, the ports at F and D in the cylinder wall being closed, the air in the crank case receives compression: when the ports F are uncovered by the piston near the end of the stroke, air under pressure enters the cylinder by the ports F as a scavenging blast and exhausts through the ports G.—*April 15th*, 1926.

TURBINE MACHINERY.

236,207. June 19th, 1925.—IMPROVEMENTS IN AND RELATING TO ELASTIC FLUID TURBINES, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C. 2.*

When a turbine is operating at full load it runs more smoothly and is less liable to vibrate than it is when running at light load, because with full load it is more evenly heated, and is subject to little, if any, temperature and pressure changes. It follows that at full load the clearances can be reduced to a minimum, and the object of this invention is to provide an improved packing for nozzle diaphragms, which is automatically adjusted by the axial deflection of the diaphragm, due to a drop in pressure



across the diaphragm, so as to vary the clearance in accordance with the load. The desired result is obtained by tapering the packing elements A, the effect on the clearance at different loads being shown in the two right-hand illustrations.—*April 8th*, 1926.

TELEGRAPHS AND TELEPHONES.

250,343. January 15th, 1925.—IMPROVEMENTS RELATING TO THERMIONIC VALVES OR ELECTRON DISCHARGE TUBES, The Mullard Radio Valve Company, Ltd., Laurence Shepheard Harley and Oswald Sidney Pratt, all of 45, Nightingale-lane, Balham, S.W. 12.

This invention relates to the production of cathode bodies for thermionic valves capable of providing adequate electron emission at relatively low temperatures. If carbon is employed as the reducing agent then the dope for coating the foundation filament may consist of 150 grammes of pure thoria, 10 grammes of carbon in the form of lamp-black and sufficient binding agent to form a paste. If metallic aluminium is used as the reducing agent the proportions may be as follows:—80 grammes of thoria, 10 grammes of aluminium in powder form with binding material. The ingredients are mixed up and form a dope or paint of a gummy consistency. The foundation filament, which is of pure or thoriated tungsten wire or pure or thoriated molybdenum wire or wire of other metal having a sufficiently high melting point, is annealed to straighten out any kinks and is stretched between two supports which serve as terminals for passing through the wire an electric current sufficient to heat it to about 100 deg. Cent. The coating mixture is painted on preferably while the filament or wire is warm, with the result that a firmly adherent coating remains on the wire visible under the microscope. Several coatings may be painted on in succession until the desired thickness is attained.—*April 15th*, 1926.

250,477. October 12th, 1925.—LOADED ELECTRICAL CONDUCTORS, *Bell Telephone Laboratories Incorporated, of New York.*

A conductor loaded in accordance with this invention is illustrated. A conducting member composed of a core A and conducting strands B is loaded with two successive layers of helically wound metallic tape, shown at C and D. The loaded conductor is impregnated with protecting fluid, as shown at E, while the insulating coating of gutta-percha is indicated at F. The lower

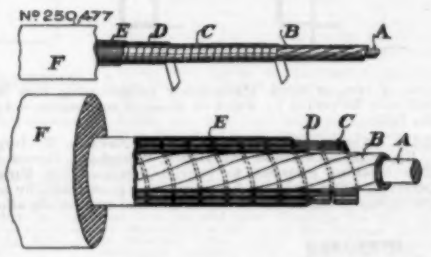
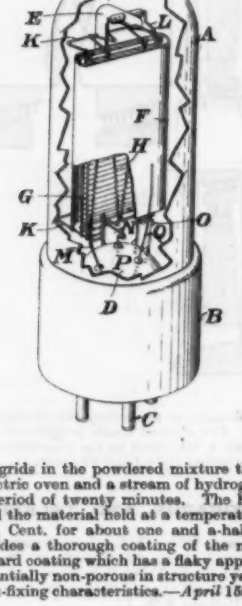


illustration is an enlarged sectional view showing more clearly the spaces between the turns of the tape which form channels, through which the protecting fluid may flow to penetrate the interstices between the conductor and the loading material and between the successive layers of loading material themselves. This method of loading submarine cables ensures uniform and complete impregnating of the conductor with the protecting fluid, so that strains in the loading material due to outside pressure are reduced to a minimum.—*April 15th*, 1926.

250,485. November 10th, 1925.—IMPROVEMENTS IN ELECTRON DISCHARGE DEVICES, *Standard Telephones and Cables, Ltd., of Connaught House, Aldwych, London, W.C. 2.*

The electron discharge device described in this specification comprises an evacuated glass vessel A, to which the usual base portion B is attached. Within the vessel there is a glass stem D to which an arbor E is fitted. This arbor provides means for supporting an anode F, a grid G, and a filament H having an alkaline earth oxide coating. The anode is in the form of a flattened cylinder and is supported by wires extending from the arbor E. The attached wire grid G is fixed within the anode F and is supported from the arbor by wires K. The cathode H is placed within the grid and supported from the upper end of the arbor by the resilient wire hooks L. This filament is supported at the lower end by resilient connections M, N and O, the wires M and O also acting as the leading-in wires. The wires P and Q are connected respectively to the grid and anode. These wires are sealed to the glass stem D, and are connected to the terminals C. In the manufacture and preparation of the electrodes for assembly within the evacuated vessel, the control electrode or grid G may be made of any desirable material such as nickel, iron or chromel—*i.e.*, nickel-chromium alloy. The grid is treated so that an aluminium coating is formed upon it, which, in the operation of the device, combines with particles thrown off the filament to form a compound or composition which is not thermionically active. As it is somewhat difficult to apply aluminium alone to the grid, it is coated with a mixture of pow-

dered aluminium and pulverised fused aluminium oxide, the latter product being commercially known as "alundum," and acting somewhat in the nature of a binding. This method of coating is known as calorising. One method of coating the grid is to provide a powdered mixture of approximately 50 per cent. aluminium and 50 per cent. of pulverised fused aluminium oxide. This mixture is placed in a nickel box and one or a number of grids are embedded in the powdered mixture. After

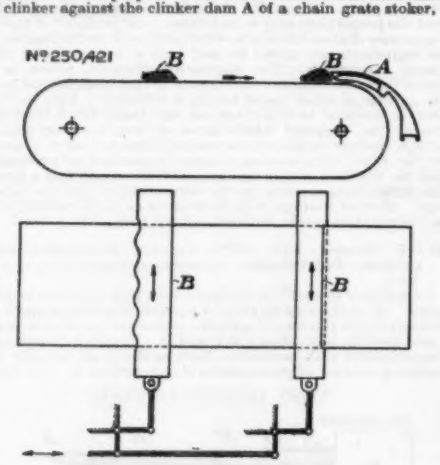


embedding the grids in the powdered mixture the box may be placed in an electric oven and a stream of hydrogen passed over the box for a period of twenty minutes. The heating current is turned on and the material held at a temperature of approximately 850 deg. Cent. for about one and a-half hours. This treatment provides a thorough coating of the metal grid, and forms a bright hard coating which has a flaky appearance. This coating is substantially non-porous in structure yet highly absorbent as to its gas-fixing characteristics.—*April 15th*, 1926.

FURNACES.

250,421. June 10th, 1925.—CHAIN GRATES, *A. G. Bloxham*, 30, *Southampton-buildings, London, W.C.* 2.

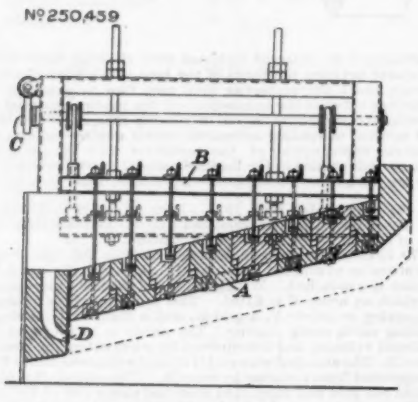
The inventors propose to check the formation of solid masses of clinker against the clinker dam A of a chain grate stoker, by



means of one, or more, transversely reciprocating bars B B, which may be cooled by water or air as is convenient.—*April 15th*, 1926.

250,439. August 27th, 1925.—FURNACE ARCHES, E. Jürges, Eppenhausenerstrasse 161, Hagen, Westphalia, Germany.

The inventor proposes to provide increased fuel burning capacity of boiler furnaces, for overcoming peak loads, by temporarily increasing the size of the furnace and incidentally afford-

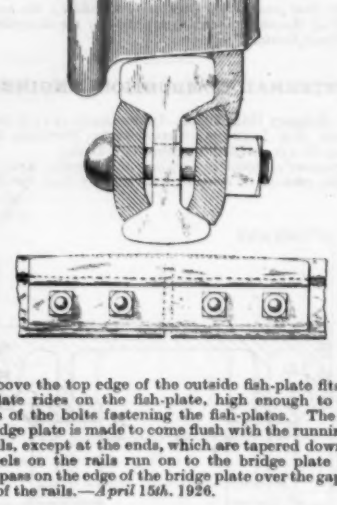


ing a fresh supply of fuel. For this purpose the furnace crown A is supported by a frame B, which can be raised or lowered by the gear C. When the crown is raised, as shown in the drawing, the supplementary fuel inlet D is uncovered.—*April 15th*, 1926.

TRAMWAYS AND RAILWAYS.

250,428. June 19th, 1925.—RAIL JOINTS, J. Rond, 30, High-street, Hornchurch, Essex.

The present method of fastening the ends of rails together by means of fish-plates and bolts is employed, supplemented by a bridge plate, the upper edge of which forms a bridge over the opening between the ends of the rails. The bridge plate is fitted to the outside of the ends of the rails, being shaped on the inside to fit closely the shape of the head of the rails and being made with a flange which fits between the top of the outside fish-plate and under the outside of the head of the rails. A groove is provided in the bottom of the bridge plate, into

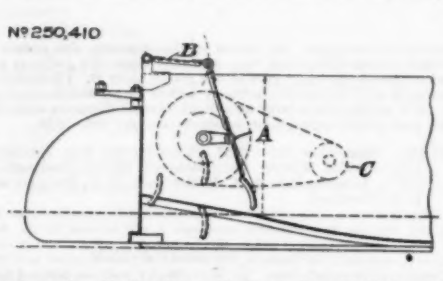


which groove the top edge of the outside fish-plate fits, and the bridge plate rides on the fish-plate, high enough to clear the four nuts of the bolts fastening the fish-plates. The top edge of the bridge plate is made to come flush with the running surface of the rails, except at the ends, which are tapered down in order that wheels on the rails run on to the bridge plate smoothly and then pass on the edge of the bridge plate over the gap between the ends of the rails.—*April 15th*, 1926.

SHIPS AND BOATS.

250,410. May 21st, 1925.—PROPULSION OF VESSELS, D. V. Hotchkiss, 1, Edward-road, Hampton Hill, Middlesex.

The inventor obviously aims at increasing the effectiveness of a paddle blade, as compared with that of one traversing a

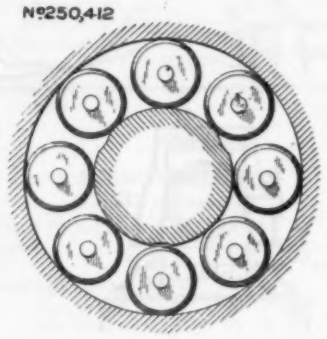


circular path. He therefore guides it round an elliptical path by means of the driving crank A and the radius link B. The crank is driven by any convenient prime mover C through gearing or chain.—*April 15th*, 1926.

MISCELLANEOUS.

250,412. May 26th, 1925.—ROLLER BEARINGS, F. C. Cowburn, Elson House, Gosport, Hants, and E. L. Godfrey, Woodchester Works, Stroud, Glos.

This invention aims at eliminating that objection to roller bearings which arises out of the fact that the rollers have a tendency to get out of alignment with the shaft. In this connection



the inventors state that it has been found that the axes of the rollers can be brought automatically into parallelism with the axes of their races by relieving the rollers of pressure from time to time. For this purpose the inner race is provided with depressions, as shown in the drawing, that provide local clearance for the rollers.—*April 15th*, 1926.

CONTRACTS.

JAMES GORDON AND CO., Ltd., of Windsor House, Kingsway, London, W.C. 2, received during the month of May orders for fifty sets of Cope's feed-water regulators for use in super-power stations.

THE GENERAL ELECTRIC COMPANY OF INDIA, Ltd., has, it is reported by cable from Calcutta, secured one of the largest orders for electrical plant ever placed in India. The order is for the complete equipment of a new power-house at Lucknow for the East Indian Railway.

THE GENERAL ELECTRIC COMPANY, Ltd., Magnet House, Kingsway, London, W.C., has received an order for twelve 50 horse-power tramcar motors from South Lancashire tramways, and another for fifty 50 horse-power tramway motors from Manchester Corporation tramways.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Shire Hall, Nottingham. East Midland District meeting. 2.30 p.m.

IRON AND STEEL INSTITUTE.—Institution of Civil Engineers, Great George street, London, S.W. 1. Annual meetings, deferred from May 6th and 7th, on account of the general strike. For programme see page 447. 10 a.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "Researches in Palestine," by Professor John Garstang. 9 p.m.

SATURDAY, JUNE 5TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South-Eastern District meeting at Richmond and Chertsey. 11 a.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Midland District meeting at Bushey. 10.45 a.m.

MONDAY, JUNE 7TH.

INSTITUTE OF PHYSICS.—Royal College of Science, South Kensington, London, S.W. 7. Lecture, "The Relationship of Physics to Aeronautical Research," by Mr. H. E. Wimperis. 5.30 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. General meeting of members. 5 p.m.

WEDNESDAY, JUNE 9TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—North-Western District meeting at Blackburn. 10.45 a.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Technical School, Mawdsley-street, Bolton. Paper, "The Various Methods of Microscopical Research in Relation to Coal-mining Problems," by Mr. James Lomax. 4 p.m.

WEDNESDAY TO SATURDAY, JUNE 9TH TO 12TH.

INSTITUTION OF WATER ENGINEERS.—Summer meeting in Manchester. For programme see page 450.

THURSDAY, JUNE 10TH.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Hotel Metropole, Leeds. Annual general meeting, 7.30 p.m., preceded by the annual students' meeting at 7.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. "Science in Antiquity," by Dr. Newton Friend. 5.15 p.m.

THURSDAY TO SATURDAY, JUNE 10TH TO 12TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Meeting in the Scottish District at Kilmarnock. For programme, see page 561.

THURSDAY TO SATURDAY, JUNE 10TH TO 19TH.

FOUNDRY TRADES' EXHIBITION at the Royal Agricultural Hall, Islington, London, N. 1. 11 a.m. each day.

FRIDAY, JUNE 11TH.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Spectrum of the Aurora," by Professor J. C. McLennan. 9 p.m.

SATURDAY, JUNE 12TH.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Visit to Nottingham and works on the river Trent. 1 p.m.

MONDAY, JUNE 14TH.

FARADAY SOCIETY.—Institution of Mechanical Engineers, Storey's Gate, London, S.W. 1. Discussion on "Explosive Reactions in Gaseous Media" (Postponed from May 13th). 2.30 p.m.

SATURDAY, JUNE 19TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—South Midland District meeting at Kettering. 11 a.m.

MONDAY TO WEDNESDAY, JUNE 21ST TO 23RD.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS.—Summer Meeting at Scarborough.

MONDAY TO SUNDAY, JUNE 21ST TO 27TH.

INSTITUTION OF NAVAL ARCHITECTS.—Summer meeting in Belgium. For programme, see page 588.

WEDNESDAY TO FRIDAY, JUNE 23RD TO 25TH.

NEWCOMEN SOCIETY.—Summer meeting at Norwich. For programme, see page 565.

WEDNESDAY TO SATURDAY, JUNE 23RD TO 26TH.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Annual general meeting and Conference at Bristol. For programme, see page 506.

THE INSTITUTION OF ELECTRICAL ENGINEERS.—Premiums for Papers:—The Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1925–26, or accepted for publication:—The Institution Premium to Mr. L. C. Grant; Ayrton Premium to Mr. S. Mavor; Fahie Premium to Messrs. B. S. Cohen, A. J. Aldridge and W. West; John Hopkinson Premium to Mr. S. Ferguson; Kelvin Premium to Mr. P. Dunsheath; Paris Premium to Mr. T. Carter; extra premiums to Professor S. P. Smith, Messrs. J. L. Thompson and H. Walmsley, and Dr. A. B. Wood; Wireless Premiums to Messrs. R. A. Watson-Watt and J. F. Herd, Mr. J. Hollingworth, and Dr. R. L. Smith-Rose and Mr. R. H. Barfield.